Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Flexibility for Delivery	)	IB Docket No. 01-185
of Communications by	)	
Mobile Satellite Service Providers	)	
in the 2 GHz and, the L-Band, and the	)	
1.6/2.4 GHz Band	)	

FURTHER COMMENTS OF INMARSAT VENTURES PLC

Gary M. Epstein
John P. Janka
Alexander D. Hoehn-Saric
LATHAM & WATKINS
555 11th Street, N.W.
Suite 1000
Washington, D.C. 20004
(202) 637-2200

Counsel for INMARSAT VENTURES PLC

March 22, 2002

TABLE OF CONTENTS

Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band	)))))	IB Docket No. 01-185

FURTHER COMMENTS OF INMARSAT VENTURES PLC

Inmarsat Ventures plc ("Inmarsat") hereby submits further comments in response to the Commission's Public Notice of March 6, 2002, requesting additional information on whether any terrestrial operations that might be authorized in MSS bands could be severed from satellite operations, and what effect doing so would have on MSS operators.[1] Inmarsat's comments focus solely on the L-band.

I. Introduction And Summary.

In its previous filings, Inmarsat has provided detailed technical analyses that demonstrate why "integrated" terrestrial use of the L-band (use by existing MSS operators in the United States) should not be permitted.[2] Such use would cause harmful interference into the Inmarsat MSS system, and disrupt critical services that Inmarsat provides to ships, airplanes and

---

[1] *See* "Commission Staff Invites Technical Comments on the Certain Proposals to Permit Flexibility in the Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz, L-Band and the 1.6/2.4 GHz Bands," FCC Public Notice, DA 02-554, March 6, 2002.

[2] *See* Comments of Inmarsat Ventures plc, IB Docket No. 01-185 (filed October 19, 2001) ("*Inmarsat Comments"*); Reply Comments of Inmarsat Ventures plc, IB Docket No. 01-185, (filed November 13, 2001)(*"Inmarsat Reply Comments"*); *Ex parte* presentation of Inmarsat Ventures plc to Mr. Bruce Franca and Mr. Julius Knapp, IB Docket No. 01-185 (filed December 6, 2001); *Ex parte* presentation of Inmarsat Ventures plc to Mr. Trey Hanbury, Mr Paul Locke, and Mr. Sankur Persaud, IB Docket No. 01-185 (filed February 26, 2002).

land mobile users, including the U.S. Navy and Coast Guard, both within and outside the United States.[3] Such terrestrial use also would consume invaluable L-band spectrum that otherwise would have been available for MSS use by operating satellite systems.[4] Unlike other MSS bands, the L-band is heavily used by multiple in-orbit systems. As the Commission has recognized, spectrum scarcity prevents each L-band MSS system from accessing all of the bandwidth that it needs.[5]

Moreover, due to frequency reuse constraints on MSS spacecraft, there are practical limitations on the number of interfering carriers that another MSS system can produce.[6] Thus, Inmarsat, and each other MSS operator in the L-band, enjoys a relatively stable interference environment. No such practical limitations would exist if the L-band were opened to terrestrial use. By providing service from many small terrestrial service cells across the United States, terrestrial operations could produce tens (if not hundreds) of thousands more interfering signals than Inmarsat ever could have been expected to anticipate from other MSS systems.[7]

Thus, terrestrial use of the L-band is fundamentally inconsistent with the international and U.S. domestic allocations for the L-band, and with the obligations of the United

---

[3] *See, e.g., Inmarsat Comments* at 12-18 & Technical Annex thereto at § 3. That Technical Annex is attached hereto as Exhibit A.

[4] *See, e.g., Inmarsat Reply Comments* at 25-26 & Supplemental Technical Annex thereto at § 5. That Supplemental Technical Annex is attached hereto as Exhibit B.

[5] *See, e.g., In re Establishing Rules and Policies for the Use of Spectrum for Mobile Satellite Services in the Upper and Lower L-band*, FCC 02-24, ¶¶ 9, 12 (released February 7, 2002) ("*Lower L-band Order*"); *Satcom Systems, Inc. and TMI Communications and Co.*, 14 FCC Rcd 20798 at ¶¶ 8, 31 (1999) ("*TMI Order*"), *aff'd, AMSC Subsidiary Corporation v.* FCC, 216 F.3d 1154 (D.C. Cir. 2000).

[6] *Inmarsat Comments* at 13-14; Exhibit A at § 3.1.

[7] *Inmarsat Reply Comments* at 9-10; Exhibit A at § 5.3.

States under the 1996 Mexico City MOU that governs the use of the L-band over North America.[8] This is not a situation that can be solved by adopting a few rules that govern the parameters of terrestrial deployment.

The discussion below highlights the ways in which *non-integrated* terrestrial operations in the L-band (operations separate and apart from satellite service) would *exacerbate* an already unacceptable interference threat into the Inmarsat system caused by proposed integrated terrestrial operations. Thus, there simply is no basis to authorize *any* terrestrial uses of the L-band—whether integrated or non-integrated.

II. Terrestrial Interference Problem in General.

Any new terrestrial use of the L-band would fundamentally change the nature of the environment within which Inmarsat has designed its MSS system to operate, in two main respects:

- Inmarsat spacecraft would receive significantly more interference from terrestrial mobile terminals than they ever would receive from the mobile earth terminals of another MSS system. The number of terrestrial handsets would far exceed the number of mobile earth terminals that ever would be deployed, or that Inmarsat ever could have expected to be deployed.

- Powerful signals from nearby terrestrial base stations would overwhelm Inmarsat handsets, which are specifically designed to receive much weaker signals from outer space—over 22,300 miles away.

Inmarsat previously has provided detailed interference analyses demonstrating why *integrated* terrestrial use of the L-Band would create five main interference problems:

- Case 1: The in-band signals of terrestrial mobile terminals located within the U.S. would interfere with the Inmarsat satellites that are trying to receive signals from ships, planes and land mobile terminals in Inmarsat coverage beams outside the U.S. This debilitating interference would disrupt co-channel communications on the Inmarsat system outside the U.S.[9]

---

[8] *Inmarsat Comments* at 21-25; Exhibit B at § 5.

[9] *Inmarsat Comments* at 13-14; Exhibit A at § 3.1.

- Case 2: The aggregate out-of-band emissions from terrestrial mobile terminals within the U.S. would interfere with Inmarsat satellites that are trying to receive signals from ships, planes and land mobile terminals located in an Inmarsat beam that covers the U.S. This problem is not one of co-channel interference. This is an interference problem to which each and every terrestrial mobile terminal would contribute when it operates within a given Inmarsat receive beam and is transmitting to a terrestrial base station. This would disrupt communications over the Inmarsat system, both within and outside the U.S.[10]

- Case 3: In-band signals from terrestrial base stations within the U.S. would overload the receivers of nearby Inmarsat mobile terminals, on ships, in planes, and on the ground. Inmarsat terminals designed to receive relatively "weak" signals from 22,300 miles away in outer space would suffer "overload" in the presence of unanticipated, high-powered, terrestrial transmitters operating in the L-Band on adjacent channels. This debilitating interference would disrupt communications on the Inmarsat system inside the U.S.[11]

- Case 4: For reasons similar to Case 3, out-of-band emissions from terrestrial base stations would interfere with the receivers of nearby Inmarsat mobile terminals, on ships, in planes, and on the ground. This debilitating interference would disrupt communications on the Inmarsat system inside the U.S.[12]

- Case 5: Self-interference from terrestrial mobile terminals would increase the spectrum requirements of MSS systems implementing an integrated terrestrial component.[13]

Thus, interference from *integrated* terrestrial uses threatens both Inmarsat's business, as well as the provision of critical safety services both within and outside the United States.[14] The L-Band supports services that are vital to the safety of those at sea and in the air. Interference from any L-band terrestrial network threatens the reliability of communications between ships and shore: emergency signals from ships at sea may be blocked or need to be repeated, thereby delaying rescue efforts. In an emergency, pilots may not be able to receive necessary instructions from air traffic controllers, thereby jeopardizing the passengers and crew. In sum, the prospect of millions of terrestrial mobile handsets and tens of thousands of terrestrial

---

[10] *Inmarsat Comments* at 14; Exhibit A at § 3.2.

[11] *Inmarsat Comments* at 14-15; Exhibit A at § 3.3.

[12] *Inmarsat Comments* at 15-16; Exhibit A at § 3.4.

[13] *Inmarsat Comments* at 16; Exhibit A at § 3.5.

[14] *Inmarsat Comments* at 17-18.

base stations raises a significant threat of increased and harmful interference to the Inmarsat system.[15]

The interference described in each of Cases 1 through 4 would also arise in the case of *non-integrated* terrestrial uses. For the reasons discussed in the next section, non-integrated terrestrial systems would cause even more severe interference into MSS systems than integrated terrestrial systems.

III. <u>Non-Integrated Terrestrial Interference Would Be Even More Severe</u>.

1. <u>Co-Channel Interference</u>.

Integrated terrestrial systems are proposed to operate in the same spectrum that their proponents have already coordinated for use by the host MSS satellite system.[16] Generally, spectrum cannot be reused in the same geographic location by different MSS systems because the mobile satellite terminal antenna typically cannot differentiate between the different satellites.[17] However, because of L-band spectrum scarcity, MSV currently uses within the United States the same L-band channels as Inmarsat uses outside the U.S. Therefore, co-channel interference from integrated systems into other MSS systems necessarily would be limited to the non-co-coverage scenario.[18] (This is Case 1, described above.).

By contrast, in the case of non-integrated terrestrial use of L-band, no limit has been proposed that would preclude a terrestrial operator from transmitting on a co-channel, co-

---

[15] Similar interference issues exist for the GPS system. *Inmarsat Comments* at 17-18.

[16] *See In the Matter of Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band, Notice of Proposed Rule Making*, IB Docket No. 01-185 and ET Docket No. 95-18, ¶¶ 29-30 (rel. August 17, 2001) ("*Flexibility NPRM*").

[17] *Inmarsat Comments* at 13.

[18] *Id.* at 13-14.

coverage basis with the Inmarsat system. In other words, absent an appropriate limitation, non-integrated terrestrial transmitters would cause harmful co-channel, co-coverage interference to MSS systems, both in the uplink band and in the downlink band.

As explained in previous Inmarsat filings, and as the Commission is well aware, the entire L-band is already assigned to different MSS systems that operate in the vicinity of North America.[19] More specifically, the entire L-band has been assigned for use by various satellite beams that cover some part of the U.S. All L-band MSS systems are operating on less spectrum than they have indicated they need, based on their current usage and projections of future demand.[20] These L-band spectrum and beam assignments are subject to change every year as part of the international coordination process.[21]

Thus, it would therefore be difficult, if not impossible, for the Commission to assign any spectrum to a non-integrated terrestrial system that is not co-coverage and co-channel with the assignments of one of the MSS systems already operating in the L-band.

The interference levels caused by co-coverage co-channel terrestrial operations would be significantly greater than for non-co-coverage operations for the following two main reasons:

(a) In the case of uplink interference, the interference scenario generally would be similar to that described in Inmarsat's Comments,[22] but the resulting interference would be more severe. In that analysis, Inmarsat calculated that the $\Delta T/T$ caused by a single terrestrial mobile terminal would be 0.213%. This was based on non-co-coverage interference

---

[19] *Inmarsat Comments* at 24-25; *Lower L-band Order*, ¶¶ 9, 12; *TMI Order*, ¶¶ 8, 31.

[20] *Lower L-band Order*, ¶¶ 9, 12; *TMI Order*, ¶¶ 8, 31.

[21] *Id.*

[22] *Inmarsat Comments* at 13-14; Exhibit A at §§ 3.1, 3.2.

into the satellite antenna's sidelobe, and (among other parameters) a satellite antenna discrimination of 20 dB. In the co-coverage case, the interference would occur in the main beam of the satellite antenna, where the satellite antenna discrimination would be zero. Thus, assuming all other parameters remain the same, the $\Delta T/T$ caused by co-coverage, co-channel transmissions of a single terrestrial mobile terminal would increase by one hundred times to more than 21%.

(b) In the case of downlink interference, a completely new interference scenario would arise, because MSS terminals in the vicinity of a terrestrial base station would potentially receive signals at the same frequency as used by the base station. Non-integrated systems would thus give rise to co-channel interference from base stations into MSS receivers. In contrast, due to existing spectrum coordination arrangements with the other MSS satellite systems, base stations of integrated terrestrial systems would interfere only into adjacent MSS channels and hence would produce "overload" of MSS receivers. Because co-channel interference inherently occurs at much lower power levels than overloading of a receiver, the introduction of non-integrated operations would exacerbate an already serious interference issue, and result in much larger areas around base stations that could not be served by MSS systems.

As an example, consider the Inmarsat Mini-M service. The overload threshold assumed in Inmarsat's analysis is –120 dBW.[23] The noise temperature of a Mini-M terminal is typically 316.2K, which translates into a noise power of –168.2 dBW (3.5 kHz bandwidth). Assuming an acceptable interference signal corresponding to 6% $\Delta T/T$ gives a co-channel interference criterion of –180.4 dBW, i.e. 60 dB less than the overload threshold. The "no go" zone where terrestrial interference would preclude the operation of MSS receivers would

[23] Exhibit A at §§ 3.3.

increase correspondingly. For example, in free space propagation conditions, the distance would increase 1000 times.

Thus, unless the Commission precluded continued MSS use of part of the L-band (which it should not do, given the shortage of spectrum) there does not appear to be any way to avoid non-integrated terrestrial systems creating co-coverage, co-channel interference into MSS systems. This situation exists because there simply is no "unneeded" L-band spectrum that is available to be set aside just for terrestrial use. To the contrary, as the Commission has repeatedly acknowledged, there is a continued shortage of L-band spectrum for MSS uses. Thus, the L-band is different from other MSS bands, such as the 2 GHz band, where incumbent MSS operators are not already using the band for commercial service.

But it still would not solve the interference problem if the Commission were to totally reverse its position on the L-band, and preclude MSS operations in part of the band to accommodate non-integrated operations. Even in that case, the non-integrated operations still would pose the interference threats described above in Cases 1-4. And, that interference would likely be even more extensive for the reasons set forth in the next section.

2. Increased Terrestrial Coverage.

MSS proponents of terrestrial services have attempted to portray the proposed operations as "ancillary" to their satellite operations, and therefore not materially different than their existing satellite operations. Inmarsat has shown, however, that the scope of any proposed terrestrial component would soon overshadow the satellite service offerings of those MSS proponents.[24]

---

[24] *Inmarsat Comments* at 26-27; Exhibit A at § 5.3; *Inmarsat Reply Comments* at 24-25.

Regardless of the resolution of that issue, deployment of a terrestrial network by a *non-integrated* operator could not be said to be "ancillary" in any respect. There would be no incentive, or any reason for that matter, for non-integrated terrestrial operators to limit their geographical coverage in any way. Instead, those operators would have every incentive to maximize coverage and reuse the L-band terrestrially as many times as possible. And, unlike an MSS operator who may not need or want to extend service through terrestrial transmitters in areas where reception of its satellite signal is not affected by buildings, a non-integrated provider has every incentive to deploy terrestrial transmitters throughout America---in rural areas, as well as in suburban and urban areas.

The natural incentive of a non-integrated terrestrial system to spread its terrestrial operations over a wider area than an integrated system increases the interference potential into MSS systems for two main reasons:

(i) In Cases 1 and 2, the average shielding between a terrestrial mobile terminal and an interfered-with satellite would be reduced. For an urban environment, where MSV originally expected to deploy its integrated terrestrial system, Inmarsat has shown that 1.9 dB is an appropriate average level of expected shielding, and 3 dB is an appropriate median level of expected shielding.[25] These values simply do not apply in the case of a suburban or rural environment where a non-integrated terrestrial operator would have every incentive to expand its system. In those cases, shielding typically would be expected to be 0 dB.[26] Thus, non-integrated terrestrial systems would likely produce a higher aggregate level of interference into the Inmarsat system.

---

[25] *Inmarsat Reply Comments* at 9-14; Exhibit B at § 3.

[26] Exhibit B at § 2.

(ii) With respect to Cases 3 and 4, Inmarsat has shown that terrestrial base stations would create certain "no-go" zones where Inmarsat mobile receive terminals no longer would properly operate due to adjacent channel interference from terrestrial base stations.[27] In other words, despite having specifically coordinated the ability to use certain frequency bands within the U.S., and having been provided market access to do so,[28] Inmarsat could find that it simply cannot provide service in many geographic areas due to interfering L-band terrestrial base stations.

In particular, Inmarsat has shown that its users could suffer terminal "overload" within 1000 meters or more of a terrestrial base station in urban areas. This distance would increase considerably in suburban and rural areas.[29] The interference suffered by aeronautical mobile terminal users, and potentially maritime users as well, would occur at even greater distances than that experienced by land-based users because of the clear line-of-sight path between the interfering base station and the Inmarsat terminal.[30] Based on Inmarsat's technical analysis, under the most likely conditions, airborne terminals could suffer overload failures as far as 22 miles away from a base station while flying below 2,500 meters.[31] A separate problem is that the out-of-band signals from Motient's base stations that fall directly in the receive band of a nearby Inmarsat mobile terminal would cause unacceptable interference into that terminal whether it is on the ground, on a ship, or on an aircraft.[32]

---

[27] *Inmarsat Comments* at 14-16; Exhibit A at §§ 3.3, 3.4.

[28] *See In re COMSAT Corporation, et. al.*, FCC 01-272 (released October 9, 2001) *("Inmarsat Market Access Order").*

[29] *Inmarsat Comments* at 14-15; Exhibit A at § 3.3.

[30] *Inmarsat Comments* at 15; Exhibit A at §§ 3.3.1, 3.3.2.

[31] *Inmarsat Comments* at 15; Exhibit A at § 3.3.2.

[32] *Inmarsat Comments* at 15-16; Exhibit A at § 3.4.

These problems would be exacerbated by non-integrated terrestrial uses, because it is reasonable to expect that a non-integrated terrestrial operator would deploy much more broadly than an integrated L-band operator ever would deploy. Both in number and in ubiquitous deployment, terrestrial base stations would likely be very similar to cellular and PCS base stations. This means that the number of "no-go" zones in the United States where Inmarsat terminals would not operate could be even greater in the case of a non-integrated terrestrial operator.

IV. Other Limitations.

The Commission asks whether there are any "band-specific rules, orders or agreements" that might pose additional technical obstacles to severing terrestrial operations from satellite operations in the L-band. There are at least three other such limitations that preclude non-integrated terrestrial operations at L-band: (i) the obligations on the United States under the Radio Regulations of the International Telecommunication Union, (ii) the obligations of the United States under the Mexico City MOU, and (iii) the Commission's own precedent in rejecting a similar proposal to allow separate terrestrial operations in a satellite band.

1. ITU Radio Regulations.

It would violate international law for the United States to authorize non-integrated terrestrial use of the L-band.[33] Under the ITU Table of Frequency Allocations, there are no primary allocations for terrestrial services in the United States at L-band. The United States is free not to follow the ITU Table within its borders, but only if doing so does not cause interference outside of the United States.[34] As the Commission has recognized many times,

---

[33] *See Inmarsat Comments* at 18-21.

[34] *See* ITU Radio Regulations, Article S4, Section S4.4; Article S8, Section S8.5. Motient does not dispute this fact. *See Consolidated Opposition to Petitions to Deny and Reply to Comments*

many different MSS systems heavily use the L-band, and there is not enough L-band spectrum to meet the needs of those systems.[35] The United States may not authorize terrestrial services in the L-band in derogation of the ITU Table, because doing so would cause unacceptable interference to the operation of Inmarsat's satellite network outside the United States, as well as to the operations of other MSS systems, such as the systems of Mexico (Solidaridad), the Russian Federation (Volna and More) and Japan (MTSAT).

Motient agrees that the Radio Regulations preclude *non-integrated* terrestrial operations.[36] Motient's legal theory that it is permissible under the Radio Regulations to deploy *integrated* L-band terrestrial operations hinges entirely on its assertion that the level of interference caused by its integrated operations would be within the range of interference that any satellite system is allowed to cause, as a matter of right, under ITU rules.[37] Inmarsat has shown why this theory is fundamentally flawed---the ITU parameter to which Motient refers is wholly inapposite in a situation where interference will be caused by a terrestrial service.[38] Inmarsat also has demonstrated that even integrated terrestrial use of the L-band would cause

---

of Motient Services, Inc., et al. at 12-13, File No. SAT-ASG-20010302-00017, et al. (filed May 7, 2001) ("*Motient Consolidated Opposition*").

[35] *Lower L-band Order*, ¶¶ 9, 12; *TMI Order*, ¶¶ 8, 31.

[36] *Motient Consolidated Opposition* at 12-13 ("[The U.S.] is obligated by treaty to allocate spectrum in a manner that is consistent with this international allocation and does not cause harmful interference to other users. In light of the harmful interference that would be caused by terrestrial-only operations, the terrestrial wireless industry's proposal to allocate the L-band to terrestrial use would cause the United States to violate its treaty obligations.") (footnote omitted).

[37] *See Motient Ex Parte Presentation* at 2-4, File No. SAT-ASG-20010302-00017, et al. (filed July 6, 2001).

[38] *Inmarsat Comments* at 19 ("The "6% $\Delta T/T$" value to which Motient refers expressly applies only to coordination of geostationary satellite networks with each other. Thus, there is no basis in the Radio Regulations for contending that Motient's proposed terrestrial service, or any other terrestrial service in derogation of the ITU Table, may permissibly cause some threshold level of interference into Inmarsat's geostationary network.") (footnote omitted).

debilitating interference into the Inmarsat system.[39] But however the Commission resolves that dispute, Motient's theory clearly is inapplicable where no satellite system is involved. Thus, it is entirely irrelevant in the case of *non-integrated* terrestrial operations.

2. Mexico City MOU

As the Commission has recognized, international coordination of the L-band for MSS uses has been difficult due to high demand for the limited amount of spectrum, and competition for that spectrum among a number of different MSS systems.[40] After seven years of negotiations, the United States, Inmarsat, Canada, Mexico and Russia entered into an agreement (and a periodic reassignment mechanism) that created a unique solution -- a flexible framework for the assignment of L-band spectrum for MSS service to North America.[41]

The 1996 Mexico City MOU results in two situations that are unique to the L-band, *do not exist in other MSS bands*, and *preclude non-integrated terrestrial operations*.

- Shared Use of the Same Spectrum. Under the Mexico City MOU, no administration has an exclusive assignment of spectrum. Spectrum used by one network within the U.S. is also used by other networks to serve other geographic areas, such as Europe. For this reason, terrestrial use of the L-band within the U.S., even if operated within the existing spectrum assignments of one network, can cause significant co-channel interference to other networks outside the U.S.[42]

- Dynamic Spectrum Reassignments. Under the Mexico City MOU, spectrum is to be reassigned among administrations on an annual basis, based on the projected demand for services on each administration's MSS system. If one administration does not need

---

[39] *Inmarsat Comments* at 12-16; Exhibit A at § 3.

[40] *TMI Order* ¶¶ 8, 31.

[41] *See International Action: "FCC Hails Historic Agreement on International Satellite Coordination, News Release,"* Report No. IN 96-16 (June 25, 1996) (the "MOU" or "Mexico City MOU").

[42] *Inmarsat Comments* at 13-14; Exhibit A at § 3.1.

certain spectrum for MSS uses, that spectrum is to be made available for MSS service by other administrations' systems.[43]

The United States would violate its obligations under the MOU if it allowed non-integrated companies to provide terrestrial service at L-band (or if it allowed MSV to provide ancillary terrestrial service in the L-band.) Because of the interference described in Cases 1 and 2 above, this would be true even if such service were restricted to those frequency assignments designated to the U.S. in the last annual coordination agreement under the MOU.[44]

Non-integrated terrestrial uses are inconsistent with the MOU for at least the following reasons:

- The MOU expressly obligates the United States to avoid situations, such as the one presented by non-integrated terrestrial operations that could potentially give rise to unacceptable interference within North America into the MSS systems covered by the MOU.[45]

- L-Band spectrum is not internationally allocated for terrestrial purposes over North America and the parties who negotiated the MOU never intended that it be used in such a manner. Neither Inmarsat nor the UK has any obligation to coordinate its L-band MSS system with any terrestrial services in the U.S.[46]

- Non-integrated terrestrial users are not, and may not be, part of the MOU negotiation process.

- The Commission has correctly noted that "any additional spectrum requirements generated by the terrestrial services should not be a factor for consideration in the annual satellite coordination review."[47]

- Once a non-integrated operator causes interference, there is no way for MSS participants in the MOU coordination process to deal with the source of that interference in the MOU process.

---

43 *Inmarsat Comments* at 21-25.

44 *Flexibility NPRM,* ¶ 49.

45 This interference situation also exists with respect to integrated terrestrial operations. *Inmarsat Comments* at 22.

46 *Id.* at 23.

47 *Id.* at 23-24; *Flexibility NPRM* at ¶ 49.

3. <u>Rejection of Terrestrial "Underlay" Proposal.</u>

Finally, terrestrial operations are akin to a similar proposal to allow "secondary" or "underlay" terrestrial use of V-band frequencies that the Commission rejected a few years ago. The Commission rejected that underlay proposal based on the mere expectation that those bands would be heavily used by satellite services, and the deployment of a separate terrestrial "underlay" service was not technically feasible:

> [W]e agree with the commenters that underlay licensing would be confusing and could undermine the benefits to be derived from providing separate spectrum for satellite and wireless services, including freedom from technical constraints, avoidance of complicated interference problems and the flexibility for technical innovation.[48]

No proponent has even attempted to explain how the proposal to open the L-band to terrestrial uses would be any different than this failed "underlay" proposal for the V-band.

V. <u>Conclusion.</u>

In conclusion, the Commission should not authorize *non-integrated* terrestrial use of the L-Band for many of the same reasons it should not authorize any *integrated* terrestrial uses, i.e.: (i) non-integrated terrestrial uses would create unacceptable inference into Inmarsat's MSS network, including vital safety services; (ii) non-integrated terrestrial uses would violate the United States' treaty obligations under the ITU Radio Regulations, and under a separate international L-band coordination agreement that governs use of the L-band over North America;

---

[48] *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz, and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations*, 13 FCC Rcd 24649, ¶¶ 23, 24 (1998). ("concept is vague and would complicate the long-term planning and investment necessary for any successful satellite service;" "would undercut the Commission's policy of identifying separate bands for satellite and wireless services and would lead to operational constraints that could inhibit technical innovations;" "would create unresolvable interference situations and would also cause significant confusion outside the U.S.").

and (iii) non-integrated terrestrial uses would exacerbate existing spectrum scarcity problems in the L-band.

Respectfully submitted,

/s/ John P. Janka
Gary M. Epstein
John P. Janka
Alexander D. Hoehn-Saric
LATHAM & WATKINS
555 11th Street, N.W.
Suite 1000
Washington, D.C. 20004
(202) 637-2200

Counsel for INMARSAT VENTURES PLC

March 22, 2002

EXHIBIT A

Technical Annex to Comments of Inmarsat Ventures plc

IB Docket No. 01-185
(filed October 19, 2001)

Technical Annex

1 Introduction

This Technical Annex addresses the technical issues raised in the Commission's "Flexibility" NPRM concerning the Motient proposal to introduce a terrestrial system into the parts of the upper and lower L band currently used by MSS satellite systems, such as Inmarsat's.[1]

Inmarsat's analysis demonstrates that the Motient terrestrial proposal would cause interference to Inmarsat and other existing and planned MSS systems. The proposed Motient terrestrial implementation, as described by Motient in its application, would lead to levels of interference that would be so high as to reduce the MSS spectrum available to the MSS community as a whole for *satellite* service. Such an impact on the international MSS community, brought about by a terrestrial use within the US that contravenes the ITU table of frequency allocations, would violate the principles embedded in the ITU's Radio Regulations, and undermine the international allocation of the L band for MSS services.

In Section 2 of this Technical Annex we briefly summarize the various interference paths of concern that would arise from the proposed Motient terrestrial mobile system. In Section 3 we provide a detailed analysis of each of these interference paths, In Section 4 we provide the rationale for our technical assumptions used in these analyses. In Section 5 we comment on the inadequacies of the information provided by Motient concerning key technical parameters of their proposed terrestrial mobile network. Finally, in Section 6, we comment on the very dubious need for Motient to make use at all of the L-band MSS frequencies for its proposed terrestrial mobile system.

This Technical Annex takes into account our review of the original Motient FCC Application, the May 7 opposition of Motient, and the July 6 and July 25 ex parte submissions of Motient.[2,3,4,5]

---

1 *In the Matter of Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band, Notice of Proposed Rule Making*, IB Docket No. 01-185 and ET Docket No. 95-18 (rel. August 17, 2001) (the "*Flexibility NPRM*").

2 *Mobile Satellite Ventures Subsidiary LLC Application for Assignment and Modification of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite System, et al.*, File No. SAT-ASG-20010302-00017, et al. (filed March 1, 2001) (the "*Application*").

3 *Motient Consolidated Opposition to Petitions to Deny and Reply to Comments*, May 7, 2001.

4 *Motient Ex-Parte Presentation*, July 6, 2001 (filed July 6, 2001).

5 *Motient Ex-Parte Presentation*, July 24, 2001 (filed July 25, 2001).

2 Interference Paths

There are essentially two different interference paths with respect to MSS systems that would be created by the terrestrial service proposed by Motient:

1. The interference from the Motient terrestrial mobile transmitters to the MSS satellite receive beam. There are three different aspects to this interference path, as follows:
   a. Interference to other MSS satellites (such as Inmarsat) that are serving geographic areas outside of the USA (see Section 3.1 below);
   b. Interference to other MSS satellites (such as Inmarsat) that are serving the U.S. (see Section 3.2 below);
   c. Interference to the Motient MSS satellites in their beams serving areas of the US adjacent to the area where the co-frequency Motient mobile transmitters are operating (see Section 3.5 below).

2. The interference from the Motient base station transmitters to the MES (Mobile Earth Station) receivers of Inmarsat and other MSS systems operating in the geographic vicinity of the Motient base stations. This interference path gives rise to two different interference mechanisms:
   a. The overload of the MES receivers due to the presence of high power Motient base station signals in an immediately adjacent frequency band. This is a function of the linearity of the front end of the MES receivers. (See Section 3.3 below)
   b. The unwanted out-of-band signals from the Motient base station transmitters that fall directly in the receive band of the MES receivers. (See Section 3.4 below)

In addition, interference from both the Motient base station transmitters and the Motient terrestrial mobile transmitters would also exist with respect to other sensitive services operating in adjacent frequency bands, such as GPS.

3 Interference Analyses

In this section we will provide a realistic assessment of the interference on the various interference paths described in Section 2 above, taking account as much as possible of the ambiguities in Motient's explanation of its terrestrial system, which are addressed in Section 4.

3.1 Uplink Interference to Co-Frequency Inmarsat Satellite Beams Serving Geographic Areas Outside of the USA

This interference path is analogous to the already existing interference path from Motient MES transmitters to the Inmarsat satellite. In the existing case there is an obligation between MSS operators to accept a certain level of interference from each others' MSS operations. The level is either a 6% increase in the system noise temperature or an agreed upon level reached during coordination between the MSS operators. There is no obligation to accept, nor any capability to accommodate, any interference from *terrestrial* mobile transmitters at L-band.

In this case the Inmarsat satellite receivers will receive co-channel interference through the satellite antenna sidelobes from the Motient terrestrial mobile transmitters. It should be noted, however, that there are several factors where previous analyses submitted by Inmarsat and Motient differ, and these are discussed in Section 4. Taking into account the values for the parameters discussed in that Section, Table 3.1-1 gives a calculation of the interference from the Motient terrestrial mobile terminals (i.e., those transmitting to the Motient terrestrial base stations) into the Inmarsat-4 satellite.[6] The degradation to the Inmarsat satellite receive system noise temperature ("ΔT/T") is calculated for a single Motient terrestrial mobile carrier.[7] Note that a single Motient terrestrial carrier anywhere on the surface of the visible Earth will degrade the Inmarsat satellite receive system noise temperature by 0.213%.

Note that some of the parameters that are used in this interference calculation are applicable to the interference situation when many Motient terminals are in operation – these are labeled as "average for many terminals" in Table 3.1-1. The reason for this is so that the results in Table 3.1-1 can be accurately scaled to the situation where there are multiple Motient terrestrial carriers in operation. This also implies of course that any single Motient terminal could produce interference levels in excess of that calculated in Table 3.1-1. The Motient mobile terminals will be distributed in various environments (indoors/outdoors, urban/suburban, etc). Hence, there will be some Motient terminals operating where the shielding is 0 dB and some Motient terminals where the power control factor is 0 dB. Based on the analysis in Table 3.1-1, one Motient carrier operating outdoors at full power would create around 0.7% increase in the Inmarsat satellite noise temperature. Thus, it would take fewer than nine such carriers to create an aggregate 6% noise increase. Alternatively, retaining the power control advantage assumed in Table 3.1-1, 14 Motient mobile carriers operating outdoors would create a 6% increase in the Inmarsat satellite noise temperature.

---

6 This analysis relates to Inmarsat-4, as it is the most spectrum efficient MSS satellite in the Inmarsat system, and is typical of the MSS systems of the future.

7 Each Motient terrestrial carrier can support up to eight Motient terrestrial terminals, because of Motient's proposed use of GSM which is a TDMA system with up to eight users accessing each 200 kHz wide RF channel.

Table 3.1-1. Calculation of Uplink Interference from Motient Terrestrial Mobile Terminals to Co-Frequency Inmarsat-4 Satellite Beams Serving Geographic Areas Outside of the USA

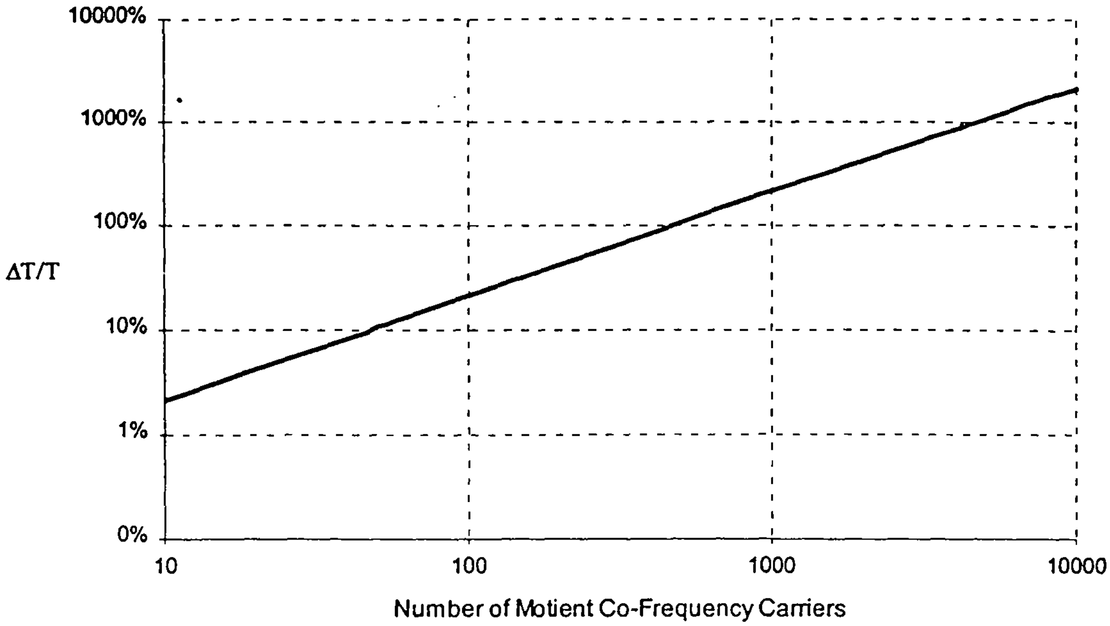
(a single Motient terrestrial carrier is assumed)

Parameter	Units	Value
Inmarsat Satellite G/T	dB/K	13
Inmarsat Satellite Antenna Gain	dBi	41
Inmarsat Satellite Receive Noise Temp	K	650
Inmarsat Satellite Receive Noise Spectral Density	dBW/Hz	-200.5
Motient Mobile Terminal EIRP	dBW/Hz	0
Motient Mobile Terminal Bandwidth	kHz	200
Motient Mobile Terminal EIRP Spectral Density	dBW/Hz	-53
Free Space Loss	dB	188.8
Shielding (average for many terminals)	dB	3
Inmarsat Satellite Receive Antenna Discrimination (average for many terminals)[8]	dB	20
Power Control Reduction (average for many terminals)	dB	2
Polarization Isolation (Linear-Circular) (average for many terminals)	dB	1.4
Received Interfering Signal Spectral Density	dBW/Hz	-227.2
ΔT/T increase per Motient carrier	%	0.213%

[8] Note that the 20 dB discrimination value used in Table 3.1-1 is an average value over the Motient service area. In practice the antenna discrimination will vary depending primarily on the how close, in geographical terms, the co-frequency Inmarsat spot beam is to the Motient transmitting mobile terminal. Where the discrimination is lower the uplink interference will be higher and vice versa.

Figure 3.1-1 shows the aggregate effect when multiple Motient terrestrial mobile co-frequency carriers are in operation.

Figure 3.1-1. Increase in Receive System Noise Temperature of the Inmarsat-4 Satellite as a Function of the Number of Motient Terrestrial Mobile Co-Frequency Carriers



Note that, from Figure 3.1-1 it can be seen that the interference levels to the Inmarsat satellite can become unacceptably high with quite small numbers of co-frequency Motient carriers. With only 28 co-channel carriers there would be a 6% increase in Inmarsat's system noise temperature, and levels such as this would be unacceptable as it would degrade the overall performance of the Inmarsat system. It is clear, however, that Motient intends to operate many more than 28 co-channel carriers. In Motient's ex parte filing of 25 July 2001, Motient states that its terrestrial network will not exceed a co-channel frequency re-use of 9,000, but states that this limitation will apply only in certain L-band spectrum, and not in other L-band spectrum. Thus, there could be 9,000 co-frequency Motient carriers operating in some parts of the L-band and even more in other parts. With as few as 500 co-frequency Motient carriers, the increase in Inmarsat system noise temperature would be approximately 100%. At this level the Inmarsat link budget would be degraded by a full 3 dB. If indeed the number of co-frequency carriers increased to 9,000, then the increase in Inmarsat system noise temperature would be 1900%, in which case the interference level would be almost twenty times higher than the noise level. Both of these numbers (500 and 9,000) are well within the range assumed by Motient itself. As noted below in Section 5.3, however, it is reasonable to expect terrestrial usage by the Motient system to exceed these numbers of carriers.

There is no ITU mechanism for coordinating any terrestrial usage in this band because there are no terrestrial primary allocations in the ITU table of frequency allocations as given in Article S5 of the Radio Regulations. Thus, there is no standard for how any additional terrestrial interference should be taken into account. Any suggestion that the 6% ΔT/T interference allowance, reserved for satellite-to-satellite network coordination, could be available to the Motient terrestrial system is therefore baseless. Inmarsat's link budgets, according to long established ITU recommended criteria, include an allowance of 20% for all external interfering sources. In Inmarsat's case, all of this interference allowance is generally used up by adjacent MSS satellite networks with each satellite network being allocated 6% $\Delta T/T$. When the latest technology, multi-beam, MSS satellites are used (as is the case between Inmarsat 4 and the proposed next generation Motient satellite), the interference between the satellite networks (without taking account of the proposed Motient terrestrial system) may be higher because of the increased frequency re-use within the networks. Therefore there may be even less interference margin available for the most technically advanced spacecraft in the Inmarsat fleet. As the Commission is well aware, there are already great difficulties in coordinating L-band MSS operations in Region 2 and the addition of a new, terrestrial interference source will exacerbate the current coordination problems.

3.2 Uplink Interference to Adjacent-Frequency Inmarsat Satellite Beams Serving the USA

The Motient proposal gives rise to the possibility of large numbers of Motient mobile terminals operating in adjacent channels to those used for Inmarsat uplink beams in the USA. The aggregate effect of the out-of-band emissions from these Motient mobile terminals would produce unacceptable interference as shown below.

We note that Motient is particularly vague about the level of out-of-band emissions from its mobile transmitters that are communicating with the Motient terrestrial base stations. In the GPS/GLONASS frequency band (1559-1610 MHz) Motient proposes specific protection levels, but no such guarantees are provided for other parts of the MSS uplink frequency band below 1559 MHz which are not being used by Motient's satellite uplinks but rather by the satellite uplinks of other MSS systems such as Inmarsat.[9] In the absence of any specifically-proposed out-of-band emission constraint we can only assume that Motient intends to comply with nothing better than the general out-of-band emission limits contained in the 47 CFR § 24.238 and which is suggested in the Commission's NPRM on this matter.

For out-of-band emissions 47 CFR § 24.238 requires an attenuation of the signal (relative to the peak power of the transmitter) of $43+10\log(P)$, where P is the peak power in Watts. Table 3.2-1 provides the analysis of this uplink interference for a single Motient terrestrial channel under this requirement. Note that the degradation to the Inmarsat satellite system noise temperature for a single Motient channel is quite small (approximately 0.001% $\Delta T/T$), but in the case of this interference the aggregate effect for multiple Motient channels must be obtained by multiplying this "single-terminal" number by the total number of Motient terrestrial channels that are used

9 Motient proposes to ensure that its base station transmitters comply with the requirement on out-of-band emissions that fall within the band 1559-1610 MHz to protect GPS/GLONASS, of less than –70 dBW/MHz with narrow-band transmissions less than –80 dBW/700Hz.

within the Inmarsat receive beam footprint.[10] At this stage we do not have sufficient information about the proposed Motient terrestrial system to be able to determine the likely or maximum number of such carriers. Considering, however, that a single Inmarsat receive spot beam could cover a geographic area as large as the north-east corridor from Washington DC to New York, then it is conceivable that there could be tens of thousands of Motient terrestrial channels simultaneously in use in such an area. In this case the additional degradation to the Inmarsat satellite noise temperature would be in excess of 10%, and therefore totally unacceptable.

Table 3.2-1. Calculation of Uplink Interference from Motient Terrestrial Mobile Terminals to Adjacent-Frequency Inmarsat-4 Satellite Beams Serving the USA

(a single Motient terrestrial carrier is assumed)

Parameter	Units	Value
Inmarsat Satellite G/T	dB/K	13
Inmarsat Satellite Antenna Gain	dBi	41
Inmarsat Satellite Receive Noise Temp	K	650
Inmarsat Satellite Receive Noise Spectral Density	dBW/Hz	-200.5
Motient MES Transmit Power to Antenna per 200 kHz Carrier	dBW	0.0
Motient MES Transmit Power to Antenna per 200 kHz Carrier	W	1.0
Motient MES Transmit Antenna Gain	dBi	0.0
Motient MES Transmit EIRP per 200 kHz Carrier (in Motient channel)	dBW	0.0
Out-of-Band Attenuation (43+10log(P))	dB	43.0
Motient MES Transmit EIRP per 200 kHz Carrier (in Inmarsat channel)	dBW	-43.0
Motient MES Transmit EIRP Spectral Density (in Inmarsat channel)	dBW	-96.0
Free Space Loss	dB	188.8
Shielding (average for many terminals)	dB	3
Power Control Reduction (average for many terminals)	dB	2
Polarization Isolation (Linear-Circular) (average for many terminals)	dB	1.4
Received Interfering Signal Spectral Density	dBW/Hz	-250.2
$\Delta T/T$ increase per Motient terrestrial carrier	%	0.001067%

10 Note that this calculation differs from that given in Section 3.1 above where the multiplying factor is the number of co-frequency channels in use in the proposed Motient terrestrial system across the entire visible Earth.

3.3 Interference to Inmarsat MES Receivers Due to Overload from the Adjacent-Channel Transmissions of the Motient Base Station Transmitters

In this section we will consider the interference resulting from overload of the Inmarsat MES receivers by the adjacent channel signals transmitted by the proposed Motient base station transmitters.

As an initial matter, the Inmarsat MES receivers have been designed to operate in an RF environment that is defined in many essential aspects by the ITU table of frequency allocations that are contained in Article S5 of the Radio Regulations. Table 3.3-1 provides an extract of these ITU frequency allocations for the majority of the L-band used by Inmarsat.

**Table 3.3-1. Extract from the ITU Tables of Frequency Allocations (Article S5 of the ITU Radio Regulations)
Relating to the L-Band MSS Downlink Frequency Band**

1 535-1 559	MOBILE-SATELLITE (space-to-Earth) S5.351A S5.341 S5.351 S5.353A S5.354 S5.355 S5.356 S5.357 S5.357A S5.359 S5.362A

Note that the entire downlink allocation from 1535-1559 MHz is reserved for MSS (Mobile-Satellite Service), and there are no significant primary allocations anywhere in the world to the terrestrial fixed or mobile services, or to any other service that might employ Earth-based transmitters.[11]

Thus, there is no reason for MSS receivers operating in this band to be designed to work in the presence of anything other than satellite-transmitted signals. If they were to be subjected to high-power terrestrially transmitted signals that are outside of their intended receive bandwidth but in the adjacent frequency bands, they are likely to be "overloaded", which means they will suffer a reduction in sensitivity or fail to operate at all, depending on the level of the interfering signal. For this reason, the Inmarsat MES receivers already in operation are not designed to reject this type of terrestrial interference, and in fact the Inmarsat specification for its receivers contains no explicit reference to the threshold level for overload to occur.

3.3.1 Interference to Land or Marine-Based Inmarsat Receivers

In the case of the Inmarsat Mini-M terminal, which is the best selling "satellite phone" in the Inmarsat system, and which is approximately the size of a laptop PC, the only reference to the level of allowable high power signals which is acceptable is that it must be able to tolerate an aggregate incident PFD (Power Flux Density) of -105 dBW/m^2 in the direction of the Inmarsat satellites. Assuming an antenna gain of +10 dBi for the Mini-M receive antenna, this is equivalent to a received signal level of -120 dBW at the output of the antenna. Although it is

11 Footnote S5.355 of the Radio Regulations provides for a secondary allocation to the Fixed Service in a 5.5 MHz portion of this band and only in certain African and Middle-Eastern countries. Footnote S5.359 provides for a primary allocation in part of this band in certain European, African and Middle Eastern countries, but deployment of such systems is very limited.

possible that the Inmarsat receivers can in practice tolerate somewhat higher adjacent band interfering signals without overload occurring, performance in this respect is not specified or guaranteed by the manufacturer.

Table 3.3-2 provides an analysis of the interfering signal level that would be received by the Inmarsat MES receiver from the Motient base station transmitter (BST) in the immediately adjacent frequency band and which could cause overload to occur. The analysis uses an EIRP per 200 kHz carrier of 19.1 dBW, as provided in Motient's application.[12] In the absence of any specific information from Motient, the analysis assumes that the Motient base station will be transmitting in a total of 5 MHz of spectrum (i.e., 25 x 200 kHz channels), which may be conservative in terms of the number of channels. The calculation shown assumes that the Inmarsat receiver is located 100 meters from the Motient base station and that a clear line-of-sight exists between them (i.e., "shielding" value of 0 dB). This scenario would seem quite likely considering Motient's assertion that the base station transmitters will be located on the top of buildings and towers. For the sake of example, we use the values of 6 dB and 4 dB for the "power control reduction" and "voice activity reduction", respectively, as proposed by Motient, although we have seen no evidence that these reductions will exist in practice. For the polarization isolation (LHCP into RHCP)[13] we use a value of 3 dB, which we believe is appropriate in a multi-path environment and for directions well away from the main beam of the Inmarsat receive antenna. We do not agree with the value that Motient uses for this parameter, which is 8 dB, and for which there is no justification at all provided by Motient. The Inmarsat receiver is assumed to have a gain of 0 dBi towards the interfering base station transmitter, which is quite conservative and the gain could actually be higher than this.[14]

The result of this analysis is that the interfering Motient signal is 64.1 dB higher than the threshold overload factor that Inmarsat can be certain of at this stage (see previous paragraph). This corresponds to an interfering signal that is almost *4 million times higher* than it should be for this scenario.

12 Motient FCC Application, Appendix A (System Design), Table 2-1 on page 30.

13 Note that Motient proposed to use Linear Vertical Polarization for its base station transmissions in its FCC Application but later changed this in its subsequent FCC filings to Left Hand Circular Polarization (LHCP), presumably in an attempt to ameliorate the serious interference problems.

14 The Inmarsat Mini-M terminal's antenna has a 60° half-power beamwidth and the 0 dBi point occurs 65° off axis.

Table 3.3-2. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End

Parameter	Units	Value
Motient Base Station EIRP per 200 kHz Carrier	dBW	19.1
Total Bandwidth of Motient Base Station Transmissions	MHz	5
Number of Motient Base Station Carriers per Cell (each 200 kHz)	#	25
Distance of Inmarsat MES Terminal from Motient Base Station Transmitter	m	100
Free Space Loss (Line-of-Sight)	dB	76.0
Shielding	dB	0
Power Control Reduction	dB	6
Voice Activity Reduction	dB	4
Polarization Isolation (LHCP-to-RHCP in a multi-path environment)	dB	3.0
Gain of Inmarsat MES Terminal towards Motient Base Station Transmitter	dBi	0.0
Received Interfering Signal Power	dBW	-55.9
Threshold for Overload of Inmarsat MES Terminal	dBW	-120.0
Margin	dB	-64.1

The results in Table 3.3-2 can be easily extrapolated to different scenarios of the physical separation between the Motient base station transmitter and the Inmarsat receiver, assuming that a line-of-sight between the two still exists. In this case a ten times increase in the distance would reduce the interference by 20 dB. Therefore at 1,000 meters separation the excess interference in Table 3.3-2 would reduce to 44.1 dB, and at 10,000 meters separation it would reduce to 24.1 dB, and so on. In these cases, the interfering signal is still more than 25,000 times and 250 times, respectively, higher than it should be. Of course, if the Inmarsat receiver is on the ground, and the Motient base station transmitter is located in an urban environment, then the line-of-sight propagation assumption would not be valid for distances in excess of 1,000 meters or so. However, in the case of an airborne Inmarsat receiver the line-of-sight assumption remains perfectly valid, and overload could occur, even at very large distances. This matter is addressed later in Section 3.3.2 below.

Under any line-of-sight circumstance, the main conclusion of this analysis remains valid: based on the current specification of the Inmarsat receivers, serious overload will occur even for large physical separations of the Inmarsat receiver from the Motient base station transmitter.

Motient has a different assessment of this interference potential.[15] Motient claims to have measured the actual overload performance of "several satellite terminals from a variety of manufacturers" and concluded that the relevant threshold value should be –88 dBW (at the antenna output) for greater than 400 kHz separation, as compared to the value of –120 dBW presented above. Inmarsat has no reason to believe that such a value of –88 dBW accurately represents the performance of the Inmarsat terminals that are deployed today and currently being manufactured, and Motient has not provided any back-up data at all for their claim concerning the overload performance. However, even if the overload threshold performance actually were –88 dBW, the excess interference in Table 3.3-2 would still be 32.1 dB, and the physical separation would have to be approximately 4,000 meters to reduce this excess to zero, under line-of-sight conditions. It would appear from this that, if the Motient terrestrial system is

[15] Motient Consolidated Opposition to Petitions to Deny and Reply to Comments, 7 May 2001.

implemented, urban (and probably suburban) areas would effectively become "no-go" zones for Inmarsat receivers, and Inmarsat's service would be relegated to a one that could reliably serve only rural areas. Inmarsat therefore would lose its ability to provide ubiquitous service due to Motient's nonconforming terrestrial service.

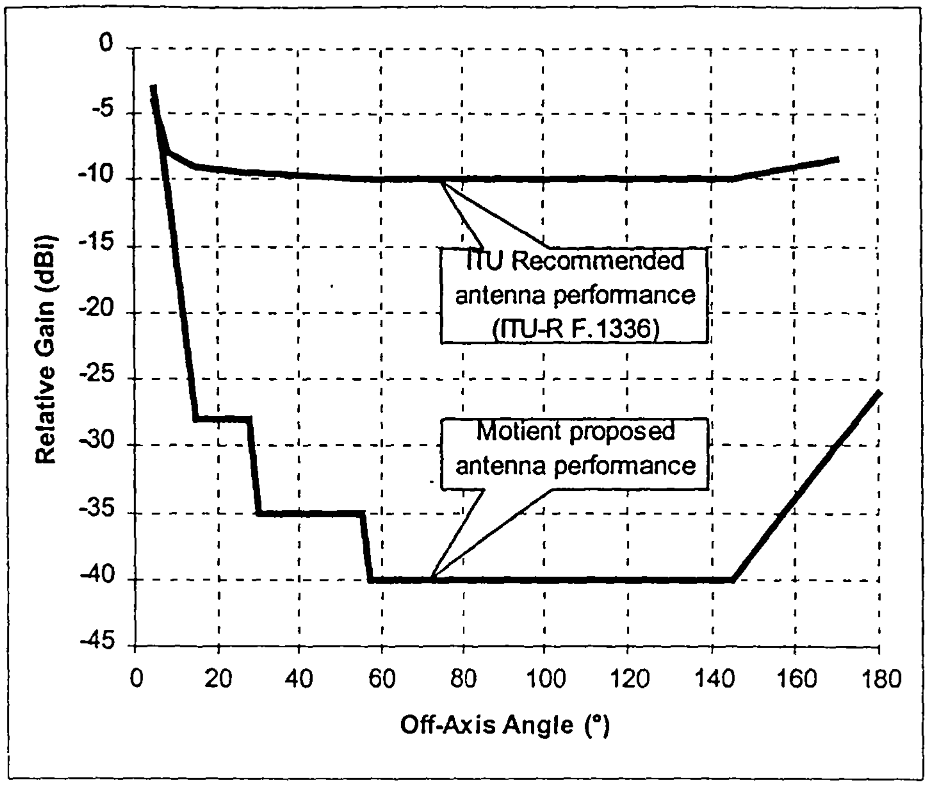
3.3.2 Interference into Airborne Inmarsat receivers

Interference to airborne Inmarsat receivers is of crucial concern for public safety reasons. Motient's analysis of this interference asserts that, provided they use their "specially designed antenna"[16], and provided they take special measures in the vicinity of airports, there should be no problem. The following analysis refutes this assertion based on the following:

- The base station transmit antenna proposed by Motient appears to have a level of performance that is unrealistically high. Figure 3.3-1 compares the performance claimed by Motient with the ITU recommended antenna gain mask for a 1.5 GHz point-multipoint base station antenna, as given in ITU-R Recommendation F.1336. Note that there is ample evidence in the technical papers of the ITU Working Parties that this antenna mask accurately represents base station antennas of this type. The surprising result is that the antenna proposed to be used by Motient exceeds the ITU Recommendation by 30 dB for large ranges of off-axis angles, and this directly impacts the interference that will be caused to airborne Inmarsat receivers. Motient does not substantiate its ability to obtain antennas that outperform the ITU standard to this extent, and Inmarsat questions whether such performance could be economically and reliably obtained.

16 Motient FCC Application, Appendix A (System Design), pages 27-29.

Figure 3.3-1. Comparison of the Motient Proposed Base Station Antenna Performance with the ITU Recommended Performance



- Motient's analysis appears to assume that there will be only one Motient 200 kHz carrier from a single Motient base station transmitter causing interference to an aircraft in flight. In fact, as shown in the analysis below, when multiple Motient carriers are taken into account the required separation distances are significantly greater and the additional possibility exists of interference *from a number of separate Motient base station transmitters* which further increases the required separation distances.

- Motient's analysis assumes that the overload threshold level for the Inmarsat receivers is –88 dBW at the antenna output. As explained above, there is no technical data provided to support Motient's claim that these receivers actually perform at this level in the face of terrestrial interference that they were not designed to reject, and Inmarsat believes the actual overload level is significantly lower than this.

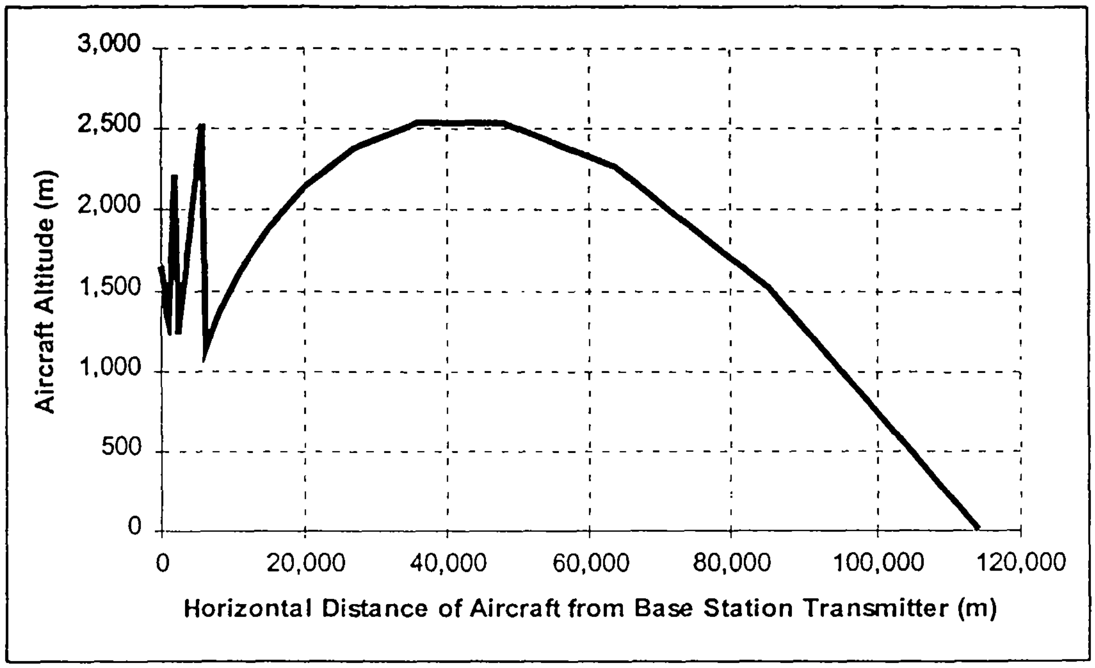
Inmarsat has performed its own initial analysis of the "safe flight path boundary" for aircraft in the vicinity of a Motient base station transmitter. Table 3.3-3 provides the details of the analysis which is essentially the same as that described in Section 3.3.1 above for the terrestrially based Inmarsat receiver, and the same assumptions are used for all the parameters as in that analysis. The difference is that the gain characteristic of the Motient base station transmit antenna is taken into account, in order to calculate the interference for a range of elevation angles (not just horizontal). In the first set of results given below in Figure 3.3-2, the proposed Motient base station antenna mask is used, and the overload threshold is assumed to be –120 dBW at the

Inmarsat receive antenna output. Note that all the results presented below are for a single Motient base station interferor and, as stated above, this may not be appropriate, and the effect of multiple Motient base station transmitters should be taken into account. The results also assume a –5° tilt angle for the Motient base station transmit antenna, unless otherwise stated and assume in all cases that the Motient base station antenna is 30 meters above the ground.

Figure 3.3-2. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Aircraft altitudes above which overload will not occur

Motient BTS Antenna Mask; -120 dBW Overload Threshold; Tilt Angle –5°
(data given in Table 3.3-3)

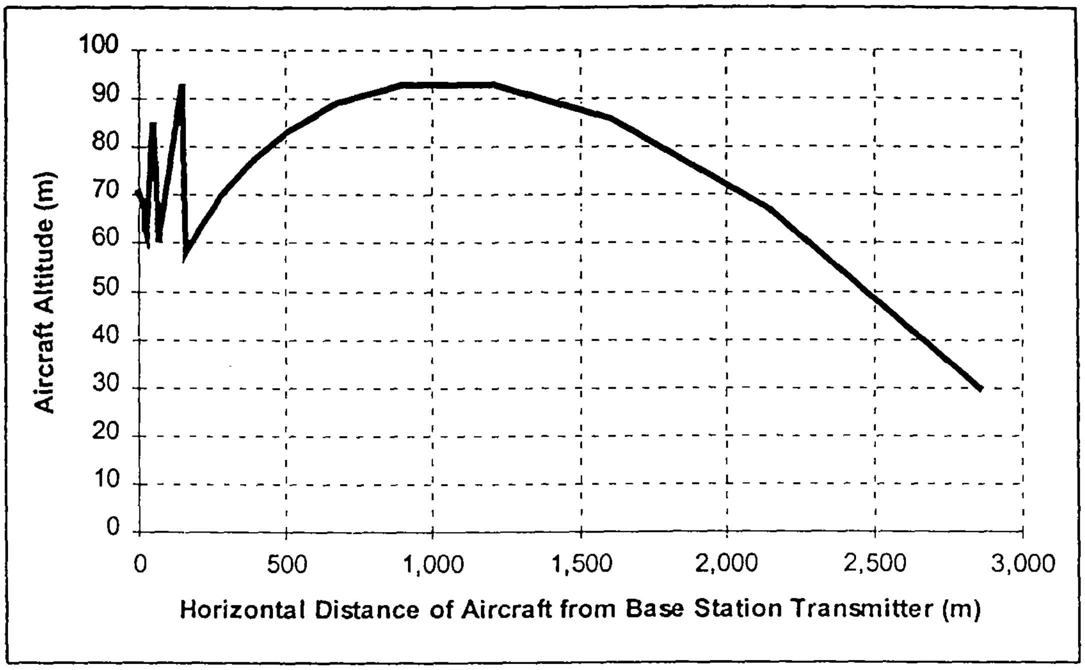


Results are also given in Figure 3.3-3 below where the only change compared to Figure 3.3-2 is the assumed overload threshold level of the Inmarsat receiver. For the sake of example, this value has been changed from –120 dBW to –88 dBW, which is the value asserted by Motient (but, as noted above, Inmarsat does not believe this value is appropriate). The results differ significantly from those given by Motient for this same threshold level: Motient suggests separation distances of less than 450 meters in the horizontal direction, but we conclude that the required separation distances are close to 3,000 meters, as shown in Figure 3.3-3.[17]

Figure 3.3-3. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Aircraft altitudes above which overload will not occur

Motient BTS Antenna Mask; -88 dBW Overload Threshold; Tilt Angle –5°



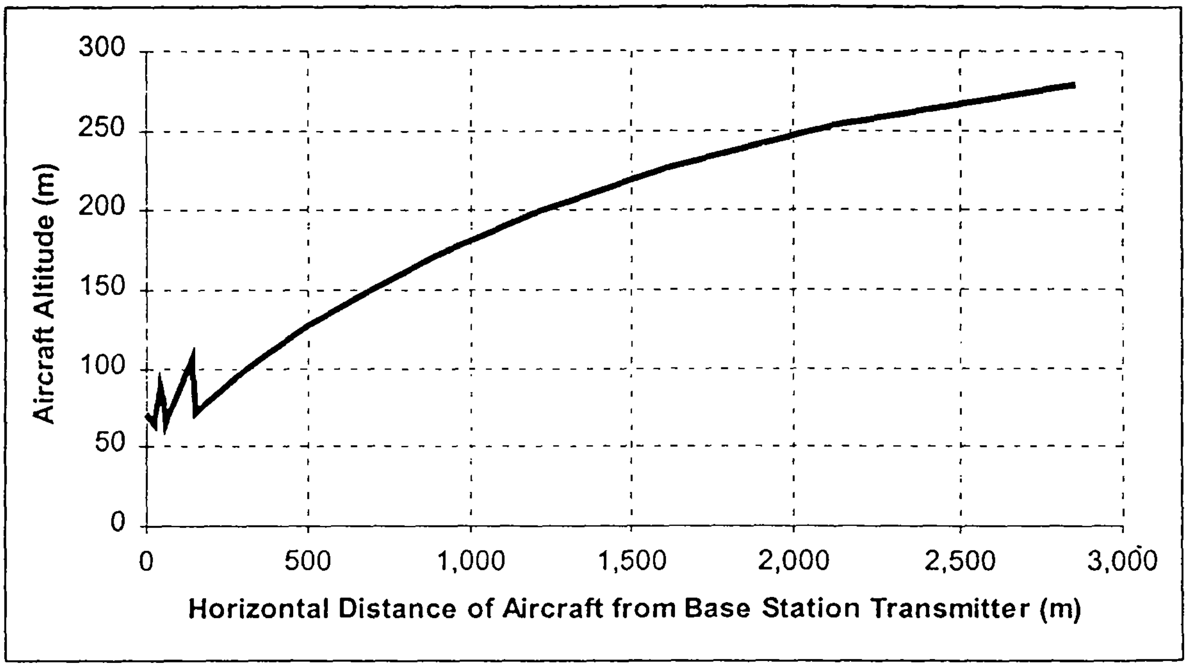
[17] Motient Consolidated Opposition to Petitions to Deny and Reply to Comments, 7 May 2001, Figure 2.

All the above results assume a –5° tilt angle for the Motient base station transmit antenna, as proposed by Motient. However, this tilt angle is a highly sensitive variable in analyzing interference potential. Figure 3.3-4 below shows the same scenario as Figure 3.3-3 but with the tilt angle set to 0° instead of –5°. There is a huge effect at large distances from the base station transmitter - the "no-go" altitude has increased from a few tens of meters to hundreds of meters. This increases the "no-go" volume around the Motient base station transmitter by many orders of magnitude. It is quite easy to foresee situations where the effective tilt angle is not always set to –5° as proposed by Motient, and there would be correspondingly huge increases in interference. Such situations could be caused by undulating or hilly terrain where the aircraft flight paths are not always above the height of the Motient base station transmit antenna, or where a faulty installation has resulted in mispointing of a Motient antenna, or unintended movement of the Motient antenna has occurred due to weather or other effects.

Figure 3.3-4. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Aircraft altitudes above which overload will not occur

Motient BTS Antenna Mask; -88 dBW Overload Threshold; Tilt Angle 0°



We have already stated above our concern about the over-optimistic antenna gain mask of the Motient base station transmitters (see Figure 3.3-1). Figure 3.3-5 below gives the aircraft separation distances necessary if the Motient base station transmit antennas only achieved the level of performance given by ITU-R Recommendation F.1336. This result assumes the overload threshold level of –120 dBW and a –5° tilt angle for the Motient base station transmit antenna. Note that aircraft flying overhead at very high altitudes and large horizontal distances from the Motient base station would be susceptible to interference in this scenario.

Figure 3.3-5. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Aircraft altitudes above which overload will not occur

ITU-R F.1336 Antenna Mask; -120 dBW Overload Threshold; Tilt Angle –5°

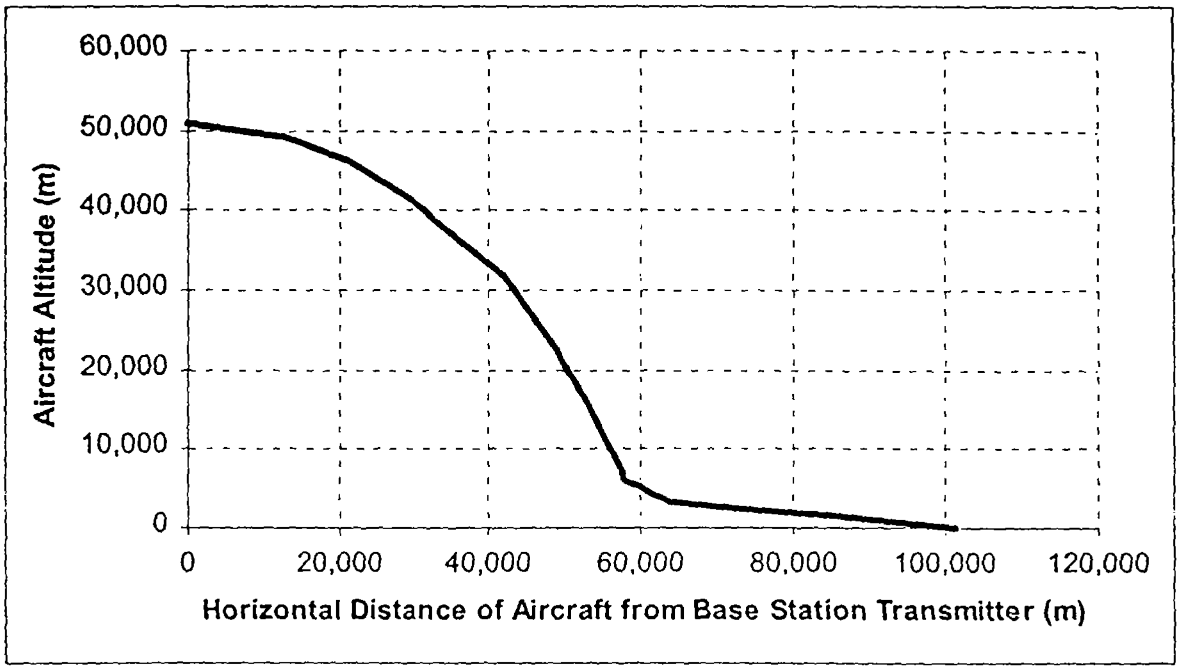


Figure 3.3-6 gives similar results assuming an overload threshold level of –88 dBW. Again this scenario gives rise to aircraft flying overhead at altitudes of less than 1,300 meters being interfered with and for considerable distances and altitudes away from the Motient base station transmitter.

Figure 3.3-6. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Aircraft altitudes above which overload will not occur

ITU-R F.1336 Antenna Mask; -88 dBW Overload Threshold; Tilt Angle –5°

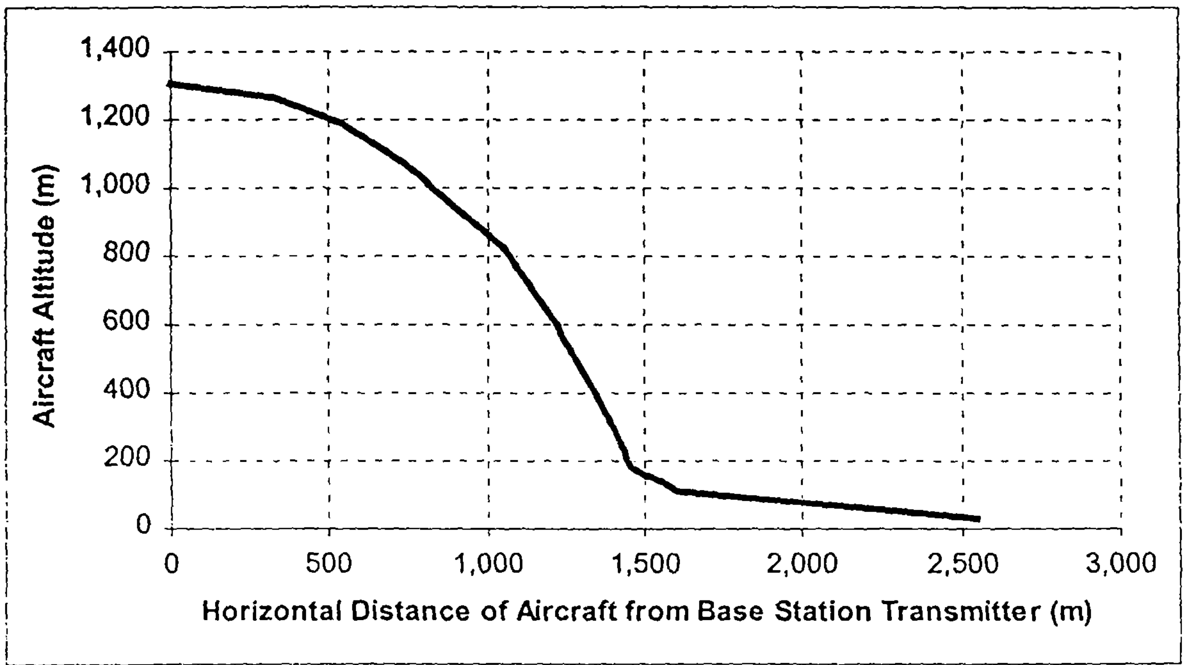


Table 3.3-3. Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End For AIRBORNE Terminals

Motient BTS Antenna Mask; -120 dBW Overload Threshold (results ploted in Figure 3.3-2)

Parameter	Units	Values																		
Elevation of Aircraft from Horizontal	°	0.0	1.0	2.0	4.0	6.0	7.0	8.0	9.0	10.0	18.0	23.0	25.0	37.0	50.0	52.0	55.0	65.0	75.0	90.0
Tilt Angle of Motient Base Station Transmit Antenna	°	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Off-Axis Angle	°	5.0	6.0	7.0	9.0	11.0	12.0	13.0	14.0	15.0	21.0	28.0	30.0	42.0	65.0	57.0	60.0	70.0	80.0	95.0
Motient Base Station Tx Power to Antenna per 200 kHz Carrier	dBW	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Motient Base Station Antenna Gain (relative to peak)	dB	-3	-5.5	-8	-13	-18	-20.5	-23	-25.5	-28	-28	-28	-35	-35	-35	-40	-40	-40	-40	-40
Motient Base Station Antenna Gain	dBi	13.0	10.5	8.0	3.0	-2.0	-4.5	-7.0	-9.5	-12.0	-12.0	-12.0	-19.0	-19.0	-19.0	-24.0	-24.0	-24.0	-24.0	-24.0
Motient Base Station EIRP per 200 kHz Carrier	dBW	16.1	13.6	11.1	6.1	1.1	-1.4	-3.9	-6.4	-8.9	-8.9	-8.9	-15.9	-15.9	-15.9	-20.9	-20.9	-20.9	-20.9	-20.9
Total Bandwidth of Motient Base Station Transmissions	MHz	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Number of Motient Base Station Carriers per Cell (each 200 kHz)	#	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Distance of Inmarsat MES Terminal from Motient Base Station Transmitter	m	113,708	85,269	63,943	35,958	20,220	15,163	11,371	8,527	6,394	6,394	6,394	2,856	2,856	2,856	1,606	1,606	1,606	1,606	1,606
Horizontal Distance of Inmarsat MES Terminal from Motient Base Station Transmitter	m	113,708	85,256	63,904	35,870	20,110	15,050	11,260	8,422	6,297	6,147	5,866	2,589	2,281	1,838	989	921	679	416	0
Vertical Distance of Inmarsat MES Terminal from Motient Base Station Transmitter	m	30	1,518	2,262	2,538	2,144	1,878	1,613	1,364	1,140	1,792	2,528	1,237	1,749	2,218	1,298	1,346	1,486	1,581	1,638
Free Space Loss (Line-of-Sight)	dB	137.1	134.8	132.1	127.1	122.1	119.6	117.1	114.6	112.1	112.1	112.1	105.1	105.1	105.1	100.1	100.1	100.1	100.1	100.1
Shielding	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Control Reduction	dB	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Voice Activity Reduction	dB	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Polarization Isolation (Linear-Circular)	dB	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Gain of Inmarsat Airborne Terminal towards Motient Base Station Transmitter	dBi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Received Interfering Signal Power	dBW	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0
Threshold for Overload of Inmarsat MES Terminal	dBW	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0	-120.0
Margin	dB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

3.4 Interference to Inmarsat MES Receivers Due to Out-of-Band Emissions from the Motient Base Station Transmitters

In this section we will address the downlink interference to the Inmarsat MES receivers caused by the unwanted (out-of-band) emissions from the Motient base station transmitters that actually fall within the receive channel bandwidth of the Inmarsat receivers.

We note that Motient is particularly vague about the level of protection that will be afforded other MSS systems whose MES receivers will be operating in the vicinity of the Motient base station transmitters. In the GPS/GLONASS frequency band (1559-1610 MHz) Motient proposes specific protection levels, but no such guarantees are provided for other parts of the MSS downlink frequency band below 1559 MHz.[18] In the absence of any specifically-proposed out-of-band emission constraint we can only assume that Motient intends to comply with nothing better than the general out-of-band emission limits contained in the 47 CFR § 24.238 and which is suggested in the Commission's NPRM on this matter.

For out-of-band emissions that are not in immediately adjacent channels, 47 CFR § 24.238 requires an attenuation of the signal (relative to the peak power of the transmitter) of 43+10log(P), where P is the peak power in Watts. Table 3.4-1 gives an analysis of the interference to Inmarsat MES receivers that would result if such an emission limit were imposed on Motient. The calculation shown assumes that the Inmarsat receiver is located 100 meters from the Motient base station and that a clear line-of-sight exists between them (i.e., "shielding" value of 0 dB), as was used for the downlink interference analysis provided above. Again, simply for the sake of example, and without accepting them as appropriate, we also use the values of 6 dB and 4 dB for the "power control reduction" and "voice activity reduction", respectively, as proposed by Motient, as in the analysis above. For the polarization isolation (LHCP into RHCP) we use a value of 3 dB, for the same reasons as described above. Finally, the Inmarsat receiver is assumed to have a gain of 0 dBi towards the interfering base station transmitter, which is considered conservative as discussed in Section 3.3 above.

The analysis presented in Table 3.4-1 is equally applicable to Inmarsat receivers that are on the ground or in aircraft.

18 Motient proposes to ensure that its base station transmitters comply with the requirement on out-of-band emissions that fall within the band 1559-1610 MHz to protect GPS/GLONASS, of less than –70 dBW/MHz with narrow-band transmissions less than –80 dBW/700Hz.

Table 3.4-1. Downlink Interference Analysis – Out-of-Band Emissions into the Inmarsat Receiver

Parameter	Units	Value
Motient Base Station Power to Antenna per 200 kHz Carrier	dBW	3.1
Motient Base Station Power to Antenna per 200 kHz Carrier	W	2.0
Motient Base Station Antenna Gain	dBi	16.0
Motient Base Station EIRP per 200 kHz Carrier (in Motient channel)	dBW	19.1
Out-of-Band Attenuation (43+10log(P))	dB	46.1
Motient Base Station EIRP per 200 kHz Carrier (in Inmarsat channel)	dBW	-27.0
Equivalent Motient Base Station EIRP per MHz Carrier (in Inmarsat channel)	dBW	-20.0
Distance of Inmarsat MES Terminal from Motient Base Station Transmitter	m	100
Free Space Loss (Line-of-Sight)	dB	76.0
Shielding	dB	0
Power Control Reduction	dB	6
Voice Activity Reduction	dB	4
Polarization Isolation (LHCP-to-RHCP in a multi-path environment)	dB	3.0
Gain of Inmarsat MES Terminal towards Motient Base Station Transmitter	dBi	0.0
Received Interfering Signal Power	dBW	-116.0
Received Interfering Signal Power Spectral Density	dBW/Hz	-169.0
Inmarsat MES Receive Noise Temp	K	150
Inmarsat MES Receive Noise Spectral Density	dBW/Hz	-206.8
ΔT/T increase per Motient 200 kHz Carrier	%	611842.9%

From Table 3.4-1 we can see that the 43+10log(P) results in an attenuation requirement of only 46.1 dB because of the low power and relatively high antenna gain of the Motient base station transmitter. The resulting equivalent EIRP in a 1 MHz bandwidth is –20 dBW/MHz and this can be directly compared with the GPS/GLONASS protection level of –70 dBW/MHz (i.e., 50 dB higher). Inevitably, as seen in Table 3.4-1, this results in an exceedingly large and totally unacceptable increase in the Inmarsat MES receive system noise temperature for a physical separation of 100 meters. If the out-of-band emission level were reduced to the same as the GPS/GLONASS protection level, the increase in the Inmarsat MES receive system noise temperature would be approximately 6% for this scenario, and still a source of unacceptable interference.

The Motient proposed system design could result in Inmarsat MES receivers operating in channels that are immediately adjacent to the channels being transmitted by the Motient base stations. For such a case the FCC Rules, at least in the case of space systems, provide even less attenuation of out-of-band signals than results from the application of the 43+10log(P) requirement. The FCC Rules, as contained in 47 CFR § 25.202(f) state the following:

> Emission limitations. The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:
>
> (1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the

authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

This would result in the interference in the region (1), which is immediately adjacent to the Motient frequency band, being 21.1 dB worse than is shown in Table 3.4-1 above. In the next adjacent band, region (2), the interference would be 11.1 dB worse.

Based on the huge shortfall in interference protection that is illustrated by the above analysis, Inmarsat believes that Motient will be unable to provide the required out-of-band attenuation of the transmissions from its terrestrial base stations that fall within the frequency bands used by the Inmarsat MES receivers. To achieve the attenuation levels in the GPS/GLONASS frequency band (EIRP < -70 dBW/MHz) the Motient base station transmitters would have to be equipped with high performance fix-tuned output filters, but all base stations would require the same output filter. In the case of the attenuation required in the parts of the L-band spectrum used by Inmarsat, the Motient base station output filters would have to be able to re-tune their "stop-bands" and their "pass-bands" annually according to the changing coordination agreements between the L-band satellite operators that are agreed at the multilateral coordination meetings. This is unlikely to be feasible from a technical and economic perspective.

Significantly, Motient's own satellite system will not suffer in the same way as Inmarsat (and other MSS operators) from unacceptably high out-of-band emissions from the Motient base station transmitters. In the event that a Motient satellite downlink becomes interfered with by a Motient terrestrial base station, then Motient would be able to switch over to the terrestrial side of the Motient system as there is certain to be a terrestrial base station close enough to provide the service. For this reason, Motient will have no incentive to achieve the necessary interference protection levels to the Inmarsat receivers.

3.5 Uplink Interference to Motient's Co-Frequency Satellite Beams Serving the USA

Inmarsat believes that the introduction of the proposed Motient terrestrial system will seriously reduce the traffic capacity that Motient can achieve in its MSS satellite system, due to self-interference. This should be of major concern to the Commission, which espouses high spectral efficiency in all communications services, but particularly for satellite ones. It is also of special concern to Inmarsat because of the way in which MSS spectrum is coordinated between the different international operators of MSS systems. The problem here is simple – if Motient squanders the MSS spectrum that it has, through inefficient use caused by self-interference from the terrestrial component, then Motient will be approaching the multilateral L-band coordination meetings with a greater requirement for MSS spectrum than they would if Motient were operating a satellite-only MSS system. This would lead to less MSS spectrum being available, as a result of international coordination, to the other MSS system operators, including Inmarsat.

Table 3.5-1 provides an analysis of the uplink interference from a single Motient terrestrial mobile carrier into the Motient satellite receive beam that is operating in an adjacent geographic area. The parameter values in this analysis that relate to the Motient satellite (satellite G/T, satellite antenna gain, satellite receive system noise temperature, satellite receive antenna gain discrimination) have been taken directly from the Motient FCC Application and subsequent filings. All the other parameters are the same as those used in section 3.1 above.

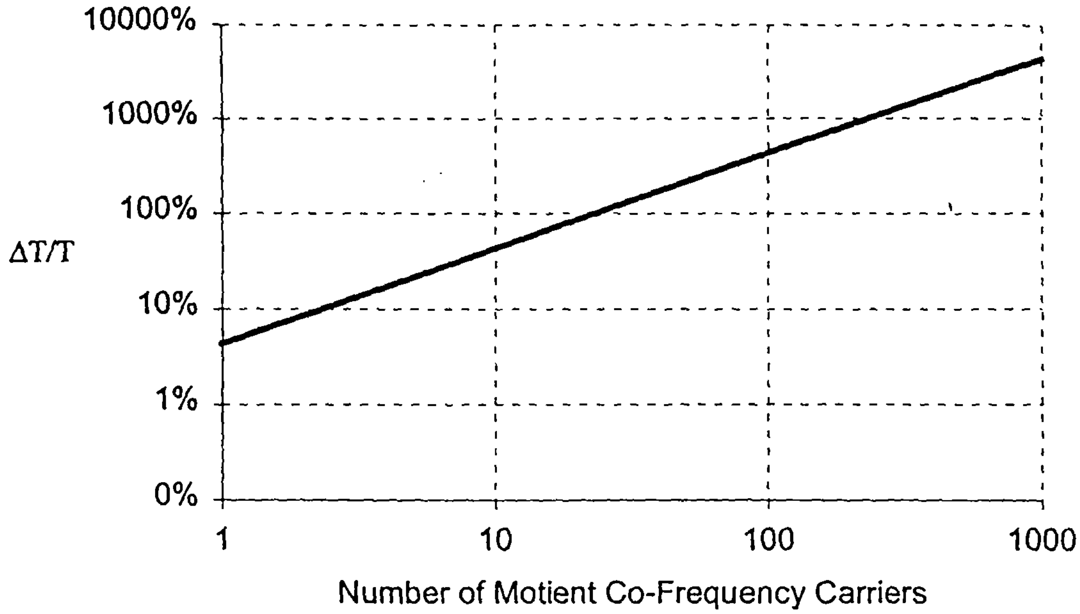
Table 3.5-1. Calculation of Uplink Interference from Motient Terrestrial Mobile Terminals to Co-Frequency Motient Satellite Beams Serving Adjacent Geographic Areas in the USA

(a single Motient terrestrial carrier is assumed)

Parameter	Units	Value
Motient Satellite G/T	dB/K	16
Motient Satellite Antenna Gain	dBi	43
Motient Satellite Receive Noise Temp	K	450
Motient Satellite Receive Noise Spectral Density	dBW/Hz	-202.1
Motient Mobile Terminal EIRP	dBW/Hz	0
Motient Mobile Terminal Bandwidth	kHz	200
Motient Mobile Terminal EIRP Spectral Density	dBW/Hz	-53
Free Space Loss	dB	188.8
Shielding (average for many terminals)	dB	3
Motient Satellite Receive Antenna Discrimination	dB	10
Power Control Reduction (average for many terminals)	dB	2
Polarization Isolation (Linear-Circular) (average for many terminals)	dB	1.4
Received Interfering Signal Spectral Density	dBW/Hz	-215.7
$\Delta T/T$ increase per Motient carrier	%	4.3%

Note that these results show that a single Motient mobile carrier will cause an increase in the Motient satellite noise temperature of more than 4.3%. Figure 3.5-1 shows the aggregate effect of multiple Motient terrestrial carriers, illustrating that the self-interference will dominate the noise with a relatively small number of co-frequency terrestrial mobile carriers in operation. For example, with only 100 terrestrial mobile carriers in operation the self-interference will be almost five times higher than the noise level. With 1000 terrestrial mobile carriers in operation the self-interference will be almost 50 times higher than the noise level.

Figure 3.5-1. Increase in Receive System Noise Temperature of the Motient Satellite as a function of the Number of Motient Terrestrial Mobile Carriers



4 Rationale for Technical Parameters Used in Interference Analysis

In this section we discuss the values we use for some of the key technical parameters used in the analyses given in Section 3 above.

4.1 Shielding Factor

In previous filings by Inmarsat and Motient there has been much debate on the appropriate value that should be assumed for shielding the interference from the Motient mobile transmitters into the Inmarsat MSS satellite receiver (or any other MSS system). In an early pleading Inmarsat assumed a shielding value of 15 dB and stipulated that "This level of shielding towards the GSO is considered a realistic average for a number of terminals operating indoors or in heavily cluttered environment." This was obviously based on an apparently incorrect assumption that all the Motient mobile transmitters would only be operating indoors, or in situations where similar signal blockage would occur. As discussed in Section 5 below, based on subsequent Motient filings, it now appears intended that the Motient mobile transmitters would be operating in quite open outside areas where signal blockage is minimal. In this case the appropriate value to assume for this shielding factor should be much less, even as low as 0 dB in certain cases.

Motient's arguments to support the use of a 15 dB shielding factor rely heavily on some propagation results reported from measurements made on NASA's ATS-6 satellite many years ago.[19] The problem with Motient's reference to these measurements is that Motient does not provide details of the "urban" and "commercial" environments, and the average figures used are not substantiated.

A useful reference for understanding the propagation environment at L-band frequencies to terminals located *inside* buildings is contained in Annex A of the ITU-R Special Publication "Terrestrial and Satellite Digital Sound Broadcasting to Vehicular, Portable and Fixed Receivers in the VHF/UHF Bands".[20] This document provides results of experiments that were undertaken to measure building penetration loss measurements at L-band. The results are quite extensive and provide the best available data to date on building loss values. Relevant results provided in this Special Publication are given in Sections 4.1.1 and 4.1.2 below.

Based on the data referred to in Section 4.1.1 and 4.1.2 below, Inmarsat believes that an average value for the shielding factor of 3 dB should be used to assess the likelihood of uplink interference when multiple interfering terminals are taken into account, although a value of 0 dB should still be used when assessing the interference from a single terminal. This assumption applies for a situation where the Motient terminals are operating both indoors and outdoors.

19 Motient's ex-parte presentation to the FCC on July 24, 2001.

20 The details of how the experiments were carried out are not provided in this filing as they are readily available in the ITU Special Publication.

4.1.1 Shielding from operations outdoors

The ITU Special Publication reports on a study conducted in 1994 using the NASA TDRS satellite at 2.05 GHz. This data has been collected to model the situation facing the MSS and BSS(Sound) services in frequencies within approximately 600 MHz above and below 2.05 GHz, and is therefore quite well suited to the L-band MSS frequency range. Actual attenuation at the lower end of the frequency range (i.e., at L-band) would be lower than the values in the publication due to the frequency dependence of radio wave propagation. Table 4.1-1 provides a summary of the results of these experiments for a fade probability of 10%. This means that for 90% of the time the fade depths are considerably less than those given (i.e., the actual attenuation of the interfering signal is lower in 90% of the cases). This is an extremely important point to keep in mind when considering the fade as an advantageous interference blocking effect rather than a disadvantageous loss of signal.

Table 4.1-1. Summary of Fade Depths at the 10% probability level in Three Types of Outdoor Environments

Geographical Area	Attenuation (Minimum) (dB)	Attenuation (Median) (dB)	Attenuation (Maximum) (dB)
Urban Areas	- 4	-10	-17
Tree-lined Roads	-1	-8	-16
Open Areas	-0.5	-0.8	-1.0

Further insight into the shielding for different probabilities of fade depth are given in Tables 4.1-2 and 4.1-3 below, which have been extracted from the Special Report. Note that the data for 50% probability is likely to be the most relevant to the assessment of average interference shielding of the Motient mobile terrestrial terminals. Even in urban areas the 50% value was very low, except for the San Francisco measurement which exhibited a higher attenuation due to the low elevation angle to the test satellite and larger numbers of tall buildings.

Table 4.1-2. Summary of Fade Depths for Tree-Lined Roads (Data from Figure A.44, page 161 of ITU Special Publication)

City	0.1 Probability Fade Exceeds Depth (dB)	0.5 Probability Fade Exceeds Depth (dB)	0.9 Probability Fade Exceeds Depth (dB)
Vicksburg, MS	-1.5 dB	< -1 dB	0 dB
Marshall, AR	-2.2 dB	< -1 dB	0 dB
Slidell, MS	-7.3 dB	-1.7 dB	0 dB
Sequoia	Not Available	-6 dB	0 dB

Table 4.1-3. Summary of Fade Depths for Urban Areas
(Data from Figure A.45, page 161 of ITU Special Publication)

City	0.1 Probability Fade Exceeds Depth (dB)	0.5 Probability Fade Exceeds Depth (dB)	0.9 Probability Fade Exceeds Depth (dB)
Albuquerque	-4 dB	-1.2 dB	0 dB
Denver	-12.8 dB	< -1 dB	0 dB
Portland	Not Available	-3.6 dB	0 dB
San Francisco (Note 1)	Not Available	-12.6 dB	0 dB

Note 1: San Francisco suffered low elevation angle to test satellite, accounting for the higher fade depth

Given the results presented above it is clear that, for a universe of mobile terminals that are randomly distributed indoors and outdoors in the urban and suburban areas that Motient would wish to eventually deploy its terrestrial system, the average attenuation is going to be significantly less than 15 dB.

4.1.2 Shielding from operations inside buildings

The ITU Special Publication shows that there is wide variation in the level of shielding from mobile transmitters *within* buildings depending on several factors, including type of building (e.g. wood or brick), number/size of windows in a building and whether the receiver is in line-of-sight, partial line-of-sight or no-line of sight. Table 4.1-2 provides the results of experiments carried out in Canada, in 1991, for attenuation inside buildings at L-band.

Table 4.1-2. Measured Building Attenuation Factors from Canadian Experiments

Type of Building	Location	Attenuation (Minimum) (dB)	Attenuation (Average) (dB)	Attenuation (Maximum) (dB)
Concrete Building	Upper Level	8.1 (mean) 3-13 (range)	21 (mean) 11-28 (range)	31.9 (mean) 25-42* (range)
	Ground Level	8.4 (mean) 3-15 (range)	17.1 (mean) 8-28 (range)	32 (mean)
Wood Building	Ground Level	9 (mean)	16 (mean) 15-17 (range)	

* This value was measured on a floor having no windows and reserved for mechanical equipment. This floor was occupied and is not a typical receiving location.

In addition to the Canadian measurements, the University of Liverpool in 1988 gave building penetration loss figures of between 7.5 and 15 dB for L band; the higher value is for the no line-of-sight condition whereas the lower value is for partial line-of-sight. BBC measurements made in 1993 resulted in a median value for building penetration loss of 12 dB. Clearly the above results show that there is wide variation in the amount of shielding provided from operations within a building. Taking the above results into account the Special Publication gives a mean building penetration loss, at ground floor level of 12 dB for L-band.

4.2 Inmarsat Satellite Antenna Discrimination toward the Motient Terrestrial Transmitters

The value for this parameter in the analysis is a function of the Inmarsat satellite performance and the angular separation (which relates to geographic separation) between the satellite receive antenna service area and the Motient terrestrial transmitter service area. In the case of the next-generation Inmarsat MSS satellites, which will use multiple small spot beams across the visible Earth, it is perfectly feasible for Inmarsat, subject to frequency coordination with Motient and other satellite systems operating over the US, to operate spot beams that are geographically close to the USA, yet which achieve an isolation of 20 dB (or less) from the service area in which co-frequency Motient MES terminals will operate. Therefore, a value of 20 dB will be used for this parameter.

4.3 Power Control of the Motient Mobile Transmitter

This is the average power reduction of the Motient mobile transmitter relative to its maximum EIRP capability, and is dynamically varied by closed loop power control depending on the instantaneous path attenuation between the Motient mobile transmitter and the base station. In the case of a single Motient mobile transmitter we should assume a value of 0 dB for this parameter as there will always be some time when there is no power reduction and the mobile transmits at maximum power. Only when there is a statistically large number of mobile transmitters should we assume an *average* power control reduction. The value to assume in this case will depend on the deployment scenarios of the mobile transmitters and the design of the power control system employed, neither of which is well defined by Motient. We therefore believe that it is appropriate to consider no more than a 2 dB average power reduction for this effect and only then when the number of co-frequency transmitters being averaged is statistically significant.

4.4 Polarization Isolation

Motient assumes a 3 dB polarization isolation factor in its analysis, based on a simplistic assumption that half the power is associated with each of the two polarization components when received by the interfered with system. In a multi-path environment, as exists for this interference path, a 3 dB factor is not correct. The ITU provides guidance in this respect in Section 2.2.3 of Appendix S8 of the Radio Regulations and proposes that a figure of 1.4 dB be used when a linearly polarized signal is interfering with a circularly polarized receiver, although this assumes line-of-sight signal paths to the interfered with satellite and negligible multi-path, so it may still be too high a value. Nevertheless, Inmarsat uses a value of 1.4 dB in this current analysis.

4.5 Motient terrestrial vs. MSS channel bandwidth difference

Channel bandwidth differences are correctly taken into account in the above analysis which is based on the spectral density of the interferor calculated assuming that the EIRP of the Motient mobile transmitter is spread evenly over its 200 kHz bandwidth. This is the best-case scenario from Motient's perspective.

4.6 Interference Allowance for Terrestrial Interference

In most interference analyses presented so far, an interference allowance of 6% ΔT/T has been assumed. Although Inmarsat also has used this value in previous filings, this has been done for illustration purposes only. In fact, as discussed elsewhere in this filing, there is no agreed criterion for interference from terrestrial transmitters into MSS systems at L-band, since there is no allocation to terrestrial mobile services. Inmarsat also pointed out in its original submissions to the FCC on this matter that the remaining, uncommitted, interference margin available on satellite systems is, by necessity, small.

Motient calculates in its ex-parte filing that the interference from its satellite component into an Inmarsat-4 spot beam is significantly less than the 6% ΔT/T interference threshold. From this Motient concludes that it can "fill up" the remaining allowance with interference from its terrestrial stations. However, Motient is making a fundamental mistake. The large number of beams on Inmarsat-4 means that it is possible to optimize the reuse between Inmarsat-4 and Motient's next-generation satellites to a much higher degree than is currently possible between Inmarsat-3 and Motient. This means that, if the ΔT/T for a particular Inmarsat beam is significantly less than 6%, there is another beam closer to the Motient service area where ΔT/T is closer to 6%. Inmarsat would therefore be able to reuse the spectrum in the second beam and should not be prevented from doing so by interference generated from terrestrial use of the spectrum by Motient.

5 Inadequacy of the Information Provided by Motient

The descriptions of the proposed Motient terrestrial system are vague and key parameters necessary to the interference calculation are missing. The technical inadequacies, and self-contradictions, of the Motient proposal are addressed individually below:

5.1 Where will the Motient mobile transmitters be operating?

Initially, from the Motient FCC application, one was led to believe that the Motient mobile transmitters would be operating only inside buildings or otherwise guaranteed to be in a position where the satellite signals were entirely blocked. It was on this basis that Inmarsat initially indicated in its Partial Petition to Deny that a blockage factor of 15 dB might be appropriate for all such mobile transmitters.[21,22] However, based on further submissions by Motient it has become apparent that the mobile transmitters will be operating outdoors where clear line-of-sight transmission paths exist to the Inmarsat satellite, and where the shielding factor is close to 0

[21] This blockage factor is the attenuation of the interfering signal from the Motient mobile transmitter in the direction of the Inmarsat (or other MSS system) satellite receive antenna.

[22] *Partial Petition to Deny of Inmarsat Ventures*, April 18, 2001.

dB.[23] This mode of operation is further supported by the Motient statement that its base station transmitters will be located on towers and tall buildings, presumably to replicate existing terrestrial cellular networks, thereby maximizing the geographic service area of the Motient terrestrial system. Discussion of the appropriate value for this all-important shielding factor, in light of what we believe is the case with the proposed Motient terrestrial system, is given in section 3.1.1 above.

5.2 Will the Motient satellite link or terrestrial link be used where both are available?

Motient clearly states that ..."The satellite path will be the preferred communications link, but if the user's satellite path is blocked, the communications link will be sustained via the fill-in base stations". The above statement of Motient is fundamentally inconsistent with sound engineering design and basic economics, and could never be the way in which the Motient system actually will be designed or operated. The relative economics of providing a communications link to the user via satellite or via terrestrial networks is so different, maybe by a factor of 100 or more in favor of the terrestrial link, that the terrestrial link would be chosen every time there is an opportunity to do so. This would inevitably lead to a geographic expansion of the Motient terrestrial network throughout the metropolitan, urban and suburban areas until a geographic limit is reached where it becomes more economic to provide the communications link by satellite, rather than terrestrial means. It is likely that this would give rise to the Motient terrestrial networks expanding to the edges of the urban, and suburban, areas, leaving the satellite to provide service only in rural areas. Furthermore, within the service areas of these Motient base station transmitters, all communications links would be provided through the terrestrial network and not via the Motient satellite. The effect of this on the interference to Inmarsat is enormous because the number of interfering transmitting Motient terminals will be orders of magnitude larger than would be the case if the Motient satellite links truly had priority over the Motient terrestrial links.

The analyses of interference scenarios presented in this Technical Annex, and the corresponding conclusions we have reached, are valid regardless of the answer on this point. Whether the Motient satellite or the Motient terrestrial links have priority will certainly affect in practice the number of Motient mobile terminals, the number of mobile channels used by the Motient system, and therefore the full extent of the interference problem, so this is an important consideration.

5.3 How many Motient mobile transmitters could there be?

Motient has made reference to its proposed terrestrial system extending to approximately 1% of the USA.[24] While such a figure seems only a small number, and therefore suggests that the Motient terrestrial system would be quite limited in terms of sources of interference, this is absolutely not the case. The 25 most-populated cities in the USA cover only about 0.18% of the geographic area of the USA, and contain approximately 32 million people. Therefore, we can

[23] *Motient Ex Parte Submissions*, July 5 and July 24, 2001.

[24] *Motient's FCC Application*, Appendix A page 25.

extrapolate and conclude that 1% of the geographical area of the USA (or five times the area containing approximately 32 million people), which could be covered by the Motient terrestrial system, would contain a very large percentage of the population of the USA, and most of the larger cities in the USA. As such, the potential for vast numbers of Motient terrestrial terminals is a serious concern and, as shown in section 3.1 above, this will directly impact the full extent of the interference into the Inmarsat system.

In its 25 July 2001 ex-parte filing, Motient states "MSV's terrestrial network will not exceed a co-channel frequency re-use of 9,000". Motient goes on to say that "The above conclusion only applies to the co-channel spectrum coordinated between Inmarsat and Motient/TMI. Additional spectrum is not subject to this limitation". From this we conclude that Motient would like, if possible, to exceed the number of 9,000 for co-channel frequency re-use in the bands used by Inmarsat, and is only limiting to this value because their own optimistic calculation suggests to them that this should be allowed. In any event, as shown in Section 3.1 above, a re-use of 9,000 would cause an increase in the Inmarsat satellite noise temperature of more than 1000%, just from the Motient mobile transmitters alone. Such a situation corresponds to the interference being ten times higher than the noise level, and clearly totally unacceptable due to its adverse impact on the performance of the Inmarsat system.

The L-band frequencies used by MSS are comparable in propagation characteristics to the 2nd generation PCS systems used in many parts of the world. As such they are well suited, from a technical perspective, for cellular communications systems employing very high levels of frequency re-use by means of sectored micro-cells. Typical North American cities could employ hundreds or thousands of such cells, allowing the same frequencies to be used hundreds or thousands of times in the same city by terrestrial transmitters. Therefore, a single receive beam on an Inmarsat satellite would likely be receiving hundreds or thousands of co-frequency interfering signals from each city in which the Motient, or similar, system is operating. This could well lead to hundreds of thousands of co-frequency interfering Motient transmitters, just from North America alone. If other countries permitted similar systems to operate, which is likely if the Commission licenses Motient to operate its terrestrial system, then the total interference into the Inmarsat satellite receive beam will be further increased as it would be vulnerable to terrestrial transmissions from all the countries visible to the satellite. Indeed, based on Motient's relationship with its Canadian partners we can already safely assume that, if Motient's proposed terrestrial usage were to be licensed by the Commission for the USA then licensing by the Canadian regulatory authorities for a similar system in Canada would soon follow. Further expansion to other countries in the region, and worldwide, would likely take place in the near future. The Commission is no doubt well aware of the difficulties of regulating, even within the jurisdiction of a single national regulator, such aggregate transmissions from the Earth's surface in order to protect satellite receive beams.[25] With aggregate transmissions encompassing many countries, the situation for controlling the aggregate would be hopeless.

[25] *See, e.g., Report of the LMDS/FSS 28 GHz Negotiated Rulemaking Committee* at ii & 90 (September 23, 1994), CC Docket 92-297 (industry unable to develop regulations that feasibly could be enforced in order to regulate aggregate interference into satellite receive beams caused by large numbers of terrestrial transmitters).

5.4 How much will the Motient terrestrial system reduce the real MSS spectrum available for Motient's satellite links?

From detailed reading of Motient's application, and subsequent FCC pleadings on this matter, we are left with no clear idea about how the spectrum will be managed between Motient's satellite system and its proposed terrestrial system, and how much of a reduction in the Motient satellite system capacity will result from the proposed terrestrial usage of the MSS frequencies. Of course we are told that Motient will only use the MSS frequencies that it has coordinated internationally for both its satellite and terrestrial systems, but this by itself is not satisfactory as it does not address the overall scarcity of L-band spectrum that exists. Inmarsat believes that, if licensed to use L-band MSS frequencies for a terrestrial service, Motient will of necessity approach the international coordination of L-band spectrum with a greater overall spectrum requirement that if it operated an MSS satellite system alone.[26]

Inmarsat has performed its own assessment of the self-interference in the Motient system and this is given in Section 3.3 of this Technical Annex.

6 Motient has provided no adequate justification for using MSS frequencies for its terrestrial system

Motient has provided no believable rationale for why it *has* to use MSS frequencies for its proposed terrestrial system.

Implicit in Motient's proposal is the idea that somehow the use of the same frequencies for both the satellite and terrestrial component of the Motient system will produce cost savings in the Motient mobile terminals. In fact the contrary is true. There is ample evidence in the mobile communications marketplace to confirm that the cost of a dual-band (or even a tri-band) mobile telephone is negligibly higher than the cost of a single-band mobile phone. However, because of the complications involved in the integration of the terrestrial and satellite spectrum into a single system, as proposed by Motient, there could be significant design and therefore cost constraints on the Motient mobile telephones, not least of which will be the severe out-of-band attenuation required to protect adjacent channel users.

[26] International coordination between the operators of L-band MSS networks takes place at multilateral coordination meetings, at which each operator requests an amount of spectrum that it plans to use in the forthcoming period. This novel approach to sharing the limited spectrum between the satellite operators relies heavily on the principle that those operators will request only the spectrum that they genuinely need at that time. If Motient is approaching this coordination with a requirement for terrestrial spectrum it will inevitably request more than if it were to operate an MSS satellite system alone.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing submission, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

Richard Barnett

Richard J. Barnett, PhD, BSc
Telecomm Strategies, L.L.C.
6404 Highland Drive
Chevy Chase, Maryland 20815
(301) 656-8969

Dated: October 19, 2001

<u>EXHIBIT B</u>

Supplemental Technical Annex to Comments of Inmarsat Ventures plc

IB Docket No. 01-185
(filed November 13, 2001)

Supplemental Technical Annex

Executive Summary

In this Supplemental Technical Annex we address five separate technical matters where Inmarsat disagrees with Motient's technical analysis of potential interference from its proposed terrestrial mobile system. These matters have arisen either in response to the Comments recently submitted to the Commission in this proceeding, or as a result of new technical information that has recently come to light.

Firstly, in Section 1, we address the serious concerns of Inmarsat concerning Motient's proposals to measure the uplink interference levels using Motient's own satellite in order to predict the levels of interference that Inmarsat will receive at its satellites. In essence, Inmarsat believes this measurement proposal is technically flawed and, at best, would produce results that are prone to serious error in a such a way that Inmarsat could suffer harmful interference that is undetected by Motient.

Secondly, we provide measured evidence in Section 2 that there could be extended periods of time when there would be essentially no shielding of the Inmarsat satellite from the interfering transmissions of the proposed Motient terrestrial mobile transmitters when those transmitters are operating in a suburban environment. Inmarsat has from the outset been leery of the prior assertions of Motient that the Motient terrestrial mobile systems would be limited to operation only in urban environments. Inmarsat believed that such terrestrial systems, if authorized, would naturally extend their geographic reach to include at least suburban areas, and Motient, in its latest Comments in this proceeding, essentially admits that this is the case. Therefore, the value of the shielding factor for suburban environments is crucially important, and the data presented here by Inmarsat clearly shows there to be a problem as the shielding factor will be extremely low.

In Section 3 we provide new insight into the propagation models that Motient has been using thus far in this proceeding. The Hess model is not appropriate to calculate the average shielding factor, and it was never intended by Hess to be used for such a purpose. An alternative set of measurement data and propagation models is provided by Inmarsat and used to demonstrate an average shielding factor for an urban environment of 1.9 dB, compared to Motient's asserted value of 22.4 dB. The ramification of this is of course that only a very small number of Motient mobile transmitters would be needed to produce harmful uplink interference into Inmarsat, and therefore the Motient proposal for a terrestrial mobile system is not viable.

In Section 4 we note that any plans for terrestrial mobile operations in the "Big-LEO" frequency band (1610-1626.5 MHz) need to be considered very carefully in terms of the out-of-band emissions causing harmful interference into the MSS uplink band above 1626.5 MHz.

Finally, in Section 5, we examine in more detail the Motient claim that it is only proposing to use spectrum for its terrestrial system that is not being used by its satellite system. As a result we demonstrate that any spectrum used by Motient for its proposed terrestrial system would directly take away spectrum from Motient's satellite system, and thereby lead to Motient making greater demands for spectrum at the multilateral Region 2 L-band coordination meetings. Such demands would be in violation of the existing multilateral coordination agreement governing the way that the limited L-band MSS spectrum is divided among the various L-band MSS systems.

1 Motient Could Not Measure In-Orbit the Interference Levels that Inmarsat Would Suffer

For the first time in this proceeding Motient has admitted, in its Comments to this NPRM, that it would be necessary for Motient to take precautions to ensure that there is no harmful uplink interference caused to Inmarsat (and other MSS operators) by the Motient terrestrial mobile transmitters.[1] Prior to this, Motient had asserted that the interference levels to Inmarsat would be negligible, even with larger numbers of Motient terrestrial mobile transmitters in operation than Motient ever plans to use.[2]

The method proposed by Motient to monitor, and thereby control, the uplink interference level to Inmarsat simply will not work. Motient proposes to somehow measure the aggregate effective uplink EIRP from the entire territory of the USA in the direction of the Motient satellite and thereby infer from that data the actual interference level that Inmarsat would suffer. Motient is not specific about how this measurement will be made, but makes generalized conclusions that its system is bound to be sensitive enough to make this measurement because the Motient satellite antenna discrimination is less than the Inmarsat antenna discrimination. The critical details of how Motient will perform this measurement are absent from Motient's filings. Inmarsat believes that this detail is lacking because these measurements will be neither feasible nor accurate, for the reasons explained in the following subsections.

1.1 The aggregate uplink signal received by Motient's satellite is not necessarily the same as that received by Inmarsat's satellite

Motient argues that the aggregate signal power from the Motient terrestrial mobile transmitters received by its satellite at 101°W will always be greater than or equal to the aggregate signal power from those transmitters received at Inmarsat's satellite locations, such as 54°W. One of the assumptions underlying this theory, as explained by Motient, is that the signal blockage to the lower elevation satellite (54°W) will always be higher than it will be to the higher elevation satellite (101°W).[3] In this sub-section we address the difference in geometry between the Motient and the Inmarsat satellites, in terms of the signal path from the Motient mobile transmitters, and why Motient's assumptions about equivalent signal blockage cannot be relied upon to provide interference protection for the Inmarsat satellite network.

Firstly we note that the Motient terrestrial system is no longer limited to being deployed in urban environments according to Motient's latest Comments. Motient now states that it proposes to deploy its terrestrial system in suburban and even "sparse suburban" areas.[4] In these

---

1 Motient Comments, Technical Appendix, pp. 3, 5-7.

2 This assertion has been strongly disputed by Inmarsat. Inmarsat has shown that a very small number of Motient mobile transmitters could cause harmful interference into the Inmarsat satellite network.

3 Motient Comments, Technical Appendix, p. 6.

4 Motient Comments, Technical Appendix, p. 4.

environments there is likely to be negligible signal blockage towards the Inmarsat satellite (i.e., with an elevation of 20° to 40°), and in many situations the signal blockage to the lower elevation Inmarsat satellite will be less than it will be to the higher elevation Motient satellite.

Secondly, there is a considerable difference in the azimuth pointing directions towards the Motient satellite at 101°W and an Inmarsat satellite such as the one operating at 54°W, for users located in the USA. Table 1-1 below provides the elevation and azimuth data for six example cities across the USA. Note that the azimuth difference ranges from almost 57° in the case of Denver to more than 90° in the case of Miami. This means that there often will be no correlation between the blockage in the two different signal paths to the two satellites.

Table 1-1. Azimuth and Elevation Pointing Directions for Six US Cities to the Motient and Inmarsat Satellites

Location	Motient Satellite at 101°W		Inmarsat satellite at 54°W	
	Azimuth (° clockwise from North)	Elevation (° above horizon)	Azimuth (° clockwise from North)	Elevation (° above horizon)
New York	218.7	35.5	151.2	39.1
Houston	191.7	55.0	119.4	33.7
Denver	174.3	44.2	117.5	21.3
Miami	221.6	52.2	131.3	48.4
Chicago	200.1	40.1	135.1	31.3
Atlanta	208.7	47.1	133.5	39.4

Based on these observations we show in Figure 1-1 below three example scenarios that are applicable to a typical suburban area, and which illustrate that the signal path to the lower elevation satellite is not likely to be blocked as much as the signal path to the higher elevation satellite. These are described below:

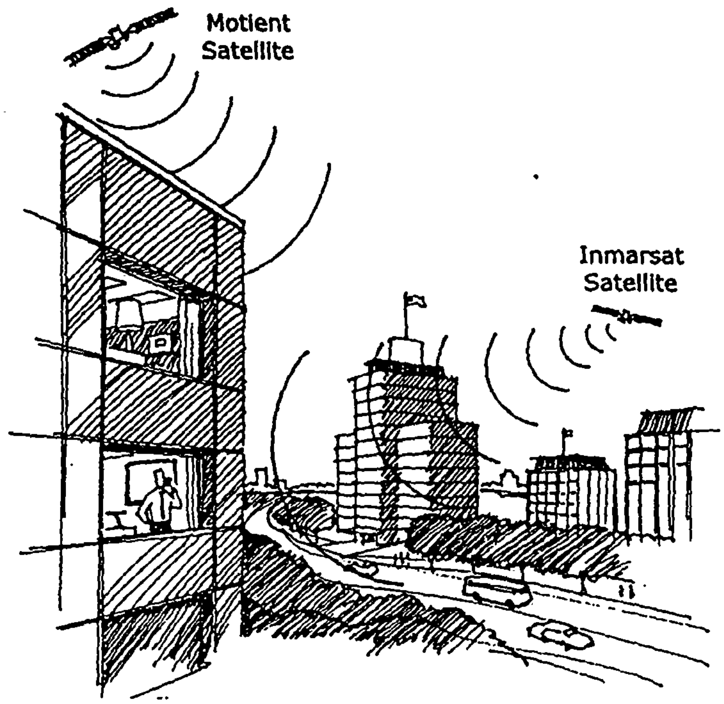
- The first shows a Motient mobile subscriber standing beside the window in an office building in which the blockage of the high elevation signal to the Motient satellite is a result of the several stories (concrete floors and ceilings) of the office building above the subscriber, whereas there is relatively small signal blockage through the window of the building towards the lower elevation Inmarsat satellite.

- The second example shows a Motient mobile subscriber walking along a sidewalk outside of a strip mall in a suburban area, and again the high elevation signal to the Motient satellite is blocked by the building and roof over the sidewalk, whereas the lower elevation signal to the Inmarsat satellite is a clear line-of-sight.

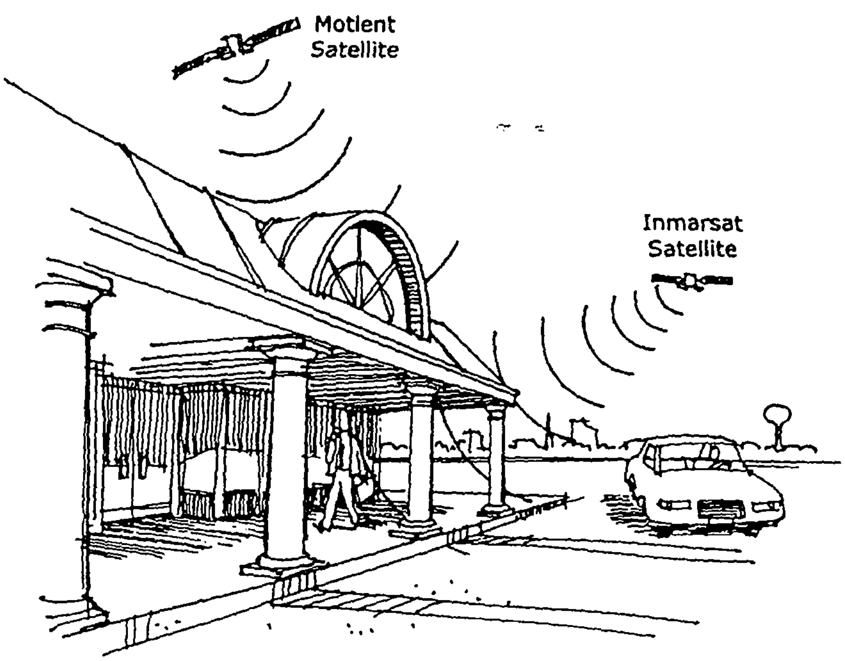
- The third example shows a Motient mobile subscriber using his telephone while inside a vehicle. The roof of the vehicle blocks the signal towards the Motient satellite but the signal to the Inmarsat satellite passes through the window of the vehicle with less signal attenuation.

Figure 1-1. Example Scenarios where the Signal Blockage is Less to the Inmarsat Satellite than to the Motient Satellite

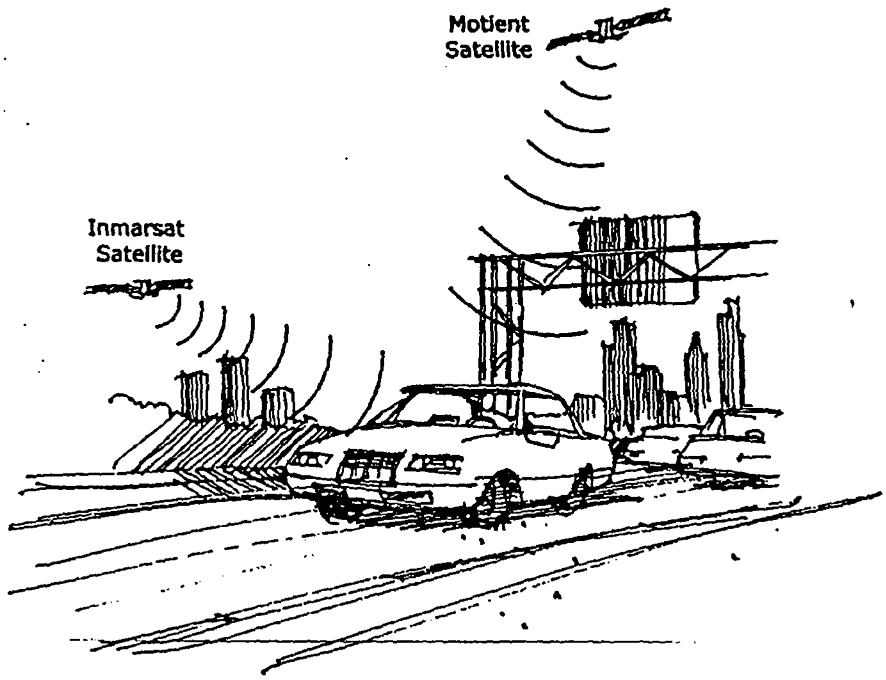
(a) Motient subscriber in office building



(b) Motient subscriber walking outside strip mall



(c) Motient subscriber in automobile



Therefore Inmarsat believes that any possible measurement that Motient could make at its own satellite would not reliably predict the interfering signal power received at the Inmarsat (or other MSS) satellite in a different part of the geostationary orbit. Such potential discrepancies are particularly problematic because only a small number of Motient mobile transmitters are needed to generate harmful interference to Inmarsat. Thus, statistical averaging of the interfering signals cannot be relied upon.

1.2 Motient's measurement would not include all the interfering contributions from across the USA that fall in the sidelobes of the Inmarsat satellite receive antenna

Motient claims that it will measure the uplink interference from its terrestrial mobile transmitters using an antenna discrimination of only –10 dB. Referring to Figure 5-1 below, which shows the –10 dB relative gain contour of a typical Motient spot beam, we can see that this gain contour exists quite close to the main beam, and this implies that such measurements based on an assumption of only –10 dB discrimination would only be accurate for a limited area surrounding the Motient receive beam. At further distances away from the Motient main beam, the Motient antenna discrimination will inevitably fall to a lower value of typically -20 dB or less. The result of this is that Motient's measurement, based on the –10 dB gain discrimination assumption, will only apply to a limited geographic area surrounding the Motient beam, and Motient's measurement system will be relatively insensitive to uplink interference originating from other geographic areas further away from the Motient beam.

To accurately measure the interference to Inmarsat, interfering signals into the Inmarsat satellite antenna sidelobes that arise from the entire geographic area of the USA would have to be measured. Therefore Motient's measurement of the interfering uplink signals originating from the area immediately surrounding one of its spot beams would severely underestimate the total interference that Inmarsat would suffer. It would therefore be necessary for Motient to aggregate the interference in some way from many of its spot beams in order to begin to assess the interference into Inmarsat, and even then it is unlikely that such a measurement would be accurate or even feasible. The measurements from each beam would include overlapping territory between the beams, and so a simple addition of the interference from each beam would not give the correct aggregate levels of interference.

Another way to consider this problem is that the satellite antennas of Motient and Inmarsat, at the frequencies where uplink interference will occur from the USA, are very different. Motient's antenna consists of a large number of spot beams covering the CONUS land mass whereas Inmarsat's antenna "sees" CONUS through its sidelobes. It would be virtually impossible to "calibrate" Motient's measurement of interference in a way to make it truly representative of the actual interference that Inmarsat would suffer.

Even if a technical means were found for Motient to accurately measure the uplink interference to Inmarsat, which we seriously doubt, there is still a fundamental problem here with a competitor of Inmarsat being in a situation where it directly controls the levels of interference into Inmarsat through means that are not transparent to Inmarsat or to the FCC.

Inmarsat therefore has serious concerns about the ability of Motient to accurately measure and control the aggregate uplink interference from its terrestrial transmitters from across the entire USA into the Inmarsat satellite network.

1.3 Motient cannot measure the interfering signal level reliably in the presence of its own signals

Motient has not indicated how it actually would measure the uplink interference from its terrestrial mobile transmitters. No specifics about this proposed measurement are provided by Motient although it repeatedly asserts that it will be able to monitor interference.[5] There appears to be no plan by Motient to include special monitoring receivers in the Motient satellite. Motient instead appears to rely upon the existing satellite receivers, and to measure the interference in the presence of its own intended satellite uplinks. The accuracy of such a measurement would be very poor because the intended signal component would dominate the measurement of the interference at the signal-to-interference levels necessary to ensure adequate protection of the Inmarsat uplinks. Thus, the interference protection measures proposed by Motient would be ineffective.

---

5 Motient Comments, Technical Appendix, pp. 5-7.

2 Measured Data Clearly Demonstrates the Negligible Shielding in Suburban Environments

In the Inmarsat Comments to this NPRM, it was suggested that an appropriate average shielding factor to use in the calculation of uplink interference from multiple simultaneously transmitting Motient terrestrial mobile transmitters is 3 dB.[6] We believe this could be an appropriate value for multiple simultaneous transmitters for some urban environments where a number of the interfering terrestrial mobile transmitters are operating inside buildings. However, based on the latest information from Motient in its Comments to the NPRM, it is clear that Motient no longer plans to restrict its terrestrial mobile system to urban environments. Motient now states that it proposes to deploy its terrestrial system in suburban and even "sparse suburban" areas.[7] In these environments there is likely to be negligible signal blockage towards the Inmarsat satellite, and use of a 3 dB shielding factor would understate the true interference potential of the proposed Motient terrestrial mobile transmitters.

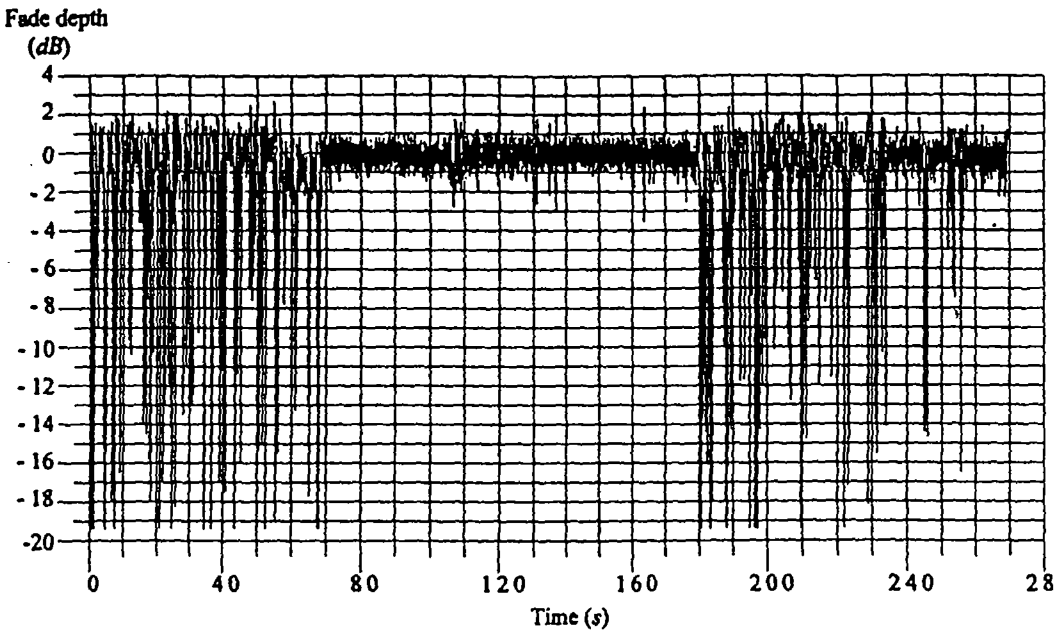
An example measurement of the signal strength of the L-band signal from an Inmarsat satellite has been reported in an ITU-R publication for a mobile user in a suburban environment and this is repeated as Figure 2-1 below.[8] The measurement gives the fade depth (in dB) relative to clear-sky as a function of time. Although some short-term fades of over 18 dB can be seen, there are long periods of time where the fade is 0 dB. In fact, over a continuous 100 second period, the fade only briefly approached 4 dB. This clearly demonstrates that Inmarsat cannot be expected to rely, as an interference protection mechanism, on shielding of the Inmarsat satellite from the transmissions of a Motient mobile user terminal in a suburban environment. This measured evidence clearly contradicts the Motient assertion that an average shielding factor of 15 dB should be assumed in the assessment the interference potential of its proposed terrestrial system.

[6] Inmarsat Comments, Section 4.1, pp. 24-26.

[7] Motient Comments, Technical Appendix, p. 4.

[8] ITU-R DSB Handbook, Annex B, Section B.10.2, pp. 402-403.

Figure 2-1. Measured satellite signal strength in a suburban environment



3 Motient's Use of the Hess Propagation Model is Inappropriate and Grossly Over-Estimates Potential Signal Blockage

Motient's assertions that the uplink interference, from the Motient mobile transmitters to Inmarsat's satellite receiver, should be acceptable relies heavily on Motient's assessment of the natural blockage that will occur on the signal path to the Inmarsat satellite. In this assessment Motient cites the Hess propagation model to support its claims that the blocking factor will average 22.4 dB in urban areas and 16.9 dB in suburban areas.[9] By contrast, Inmarsat believes this blocking factor (i.e., the average attenuation) is likely to be 3 dB or less, even in urban areas. This almost 20 dB discrepancy is very significant in the overall assessment of uplink interference.

3.1 Inadequacy of the Hess model for calculation of interference shielding

The Hess model is based upon the first propagation experiments that were targeted towards land mobile satellite communications which were conducted in 1980 by observing 860 MHz and 1550 MHz transmissions emanating from NASA's ATS-6 spacecraft.[10] The Hess model is based on statistical manipulation of data aimed at defining "small-scale" and "large-scale" probabilities

9 Motient Comments, Technical Appendix, pp. 1, 4.

10 Hess, G.C., "Land-Mobile Satellite Excess Path Loss Measurements", IEEE Transactions on Vehicular Tech., Volume VT-29, No. 2.

of the path attenuation data.[11] The whole purpose of the Hess model is to aid in quantifying the propagation conditions that will affect the link availability for MSS users, where the attenuation along the signal path degrades the signal level and performance of an MSS link for a single user at a time. The model predicts the percentage of time that the path attenuation will be less than a certain value (e.g., less than 25 dB of path attenuation for 90% of the time). These probabilities range from 50% to 99% with the latter value giving the highest fade attenuation value. The Hess model *does not* predict the level of fades occurring at percentages smaller than 50%, which corresponds to the weaker fades. The Hess model does not provide this data because it is designed to deal with path attenuation as a problem to be surmounted, not as a device that is to be relied upon as a primary means of preventing unacceptable interference into another system.

By contrast, in order to assess the appropriate blocking factor for purpose of calculating the uplink interference from the Motient mobile transmitters into the Inmarsat satellite receiver we need to assess the *aggregate* interference from a number of mobile transmitters by predicting the path attenuation averaged across all those transmitters. This requires knowledge of the path attenuation and associated probability for all percentages smaller than 50% - a range that Hess's model does not predict. Determining the percentages of time that little or no attenuation is expected is critical when one is relying on attenuation to prevent interference. For example, it is not enough to know that attenuation will be less that 9.5 dB for 90% of the time in a semi-urban environment. One also needs to know how often the attenuation will be 0, 1, or 2 dB, and any other value below 9.5 dB. To perform the necessary calculations, we therefore cannot use the Hess model.

3.2 Motient's incorrect understanding of the average shielding factor

Relying on data from the Hess model, Motient attempts to calculate the uplink interference to Inmarsat asserting an "average" shielding factor of 22.4 dB (for urban areas) for all the Motient mobile transmitters.[12] There are two flaws with this assumption. First, as noted below, the Hess

11 Hess obtained the small-scale probabilities by accumulating many short-term fade files derived from approximately 100 m driving intervals. Assuming a speed in an urban community of 10 m/s ($\approx$22 miles/hour), each small-scale file represents approximately 10 seconds of data or the time of a mobile user to make a short comment. A cumulative fade distribution was constructed for each short-scale file (say file i) and a "success" percentage (e.g., 90%) was defined and related to the corresponding fade being smaller than, say A_{qi} for the ith file. Other cumulative distributions were constructed comprising all values of i (ith short-scale file) and the corresponding values of A_{qi} were noted. The "large-scale" probability" was derived by taking the cumulative fade distribution of the values of A_{qi} at a specific percentage level. This new probability (large-scale) thus represents the probability of being smaller than individual fade levels belonging to successful phone comments (e.g., defined by the 90% level) over a large area of coverage. The physical significance that may be attributed to the large-scale probability is that it predicts the probability that the fade will be less than a particular fade level over many kilometers of driving, assuming a given small-scale probability which denotes the likelihood of successful reception (e.g., 90% of the time) over an approximate 100 m driving distance.

12 Motient Ex-Parte Presentation, July 6, 2001 (filed July 6, 2001), pp. 5-6.

model simply does not provide data about "average" attenuation - the 50% probability value in the Hess model is a *median* attenuation figure. Median data represent different quantities than average data. Second, use of the 22.4 dB value is misleading. Although impossible to verify from the information supplied by Motient, this value of 22.4 dB would appear to be the attenuation derived from the Hess model using a value of approximately 90% for both the large-scale and small-scale probabilities, for an urban environment. Why Motient chose probability data corresponding to 90% is not clear – presumably in order to derive as high an attenuation value as possible. Use of this value is misleading because this value tells you that there is a 90% chance that actual attenuation will be less that 22.4 dB, without indicating the chance that actual attenuation will be so low, such as 0 dB or 1 dB, that it will be insignificant as a means of shielding. It is interesting to note that if both the small-scale and large-scale probabilities are reduced to 50% with all other parameters constant, under the Hess model, the attenuation figure drops from 22.4 dB to 7 dB for the urban environment (i.e., there is a 50% chance attenuation will be less that 7 dB).

Even use of the 50% probability data from the Hess model is incorrect for ascertaining the ability of Motient to protect the Inmarsat system. The 50% probability value simply means that half the time the fade is higher than a certain value and half the time it is lower than this value. It is not the average attenuation value that can be applied to all the interfering mobile transmitters. It takes no account of the operation of interfering mobile transmitters in situations where the path attenuation is significantly less than the 50% value.

Inmarsat believes that the only way to correctly calculate the aggregate interference from all the transmitting Motient mobile terminals is to use a propagation model that provides attenuation data for the full range of probabilities from essentially 0% to 100% of the time. Data from the Hess model, which only predicts attenuation at probability levels of 50% and greater, is just not suitable for this. An alternative propagation model that is appropriate for this calculation is discussed in the following sub-section.

3.3 Inmarsat's calculation of the average shielding factor

In this sub-section we will present a rigorous way of calculating the aggregate uplink interference from the Motient mobile transmitters. This is based on satellite measurements performed in Tokyo (urban environment) at 1.5 GHz by Karasawa et al. [13] and the three-state fade model described by Goldhirsh and Vogel [14]. Figure 3-1 below provides the typical results for the Tokyo urban environment. The left set of curves denotes measured and modeled fade

---

13 Karasawa, Y., K. Minamisono, and T. Matsudo [1995], "A propagation channel model for personal mobile-satellite services," Proceedings of Progress of Electromagnetic Research Symposium of the European Space Agency (ESA), Noordwijk, The Netherlands, July, pp. 11-15.

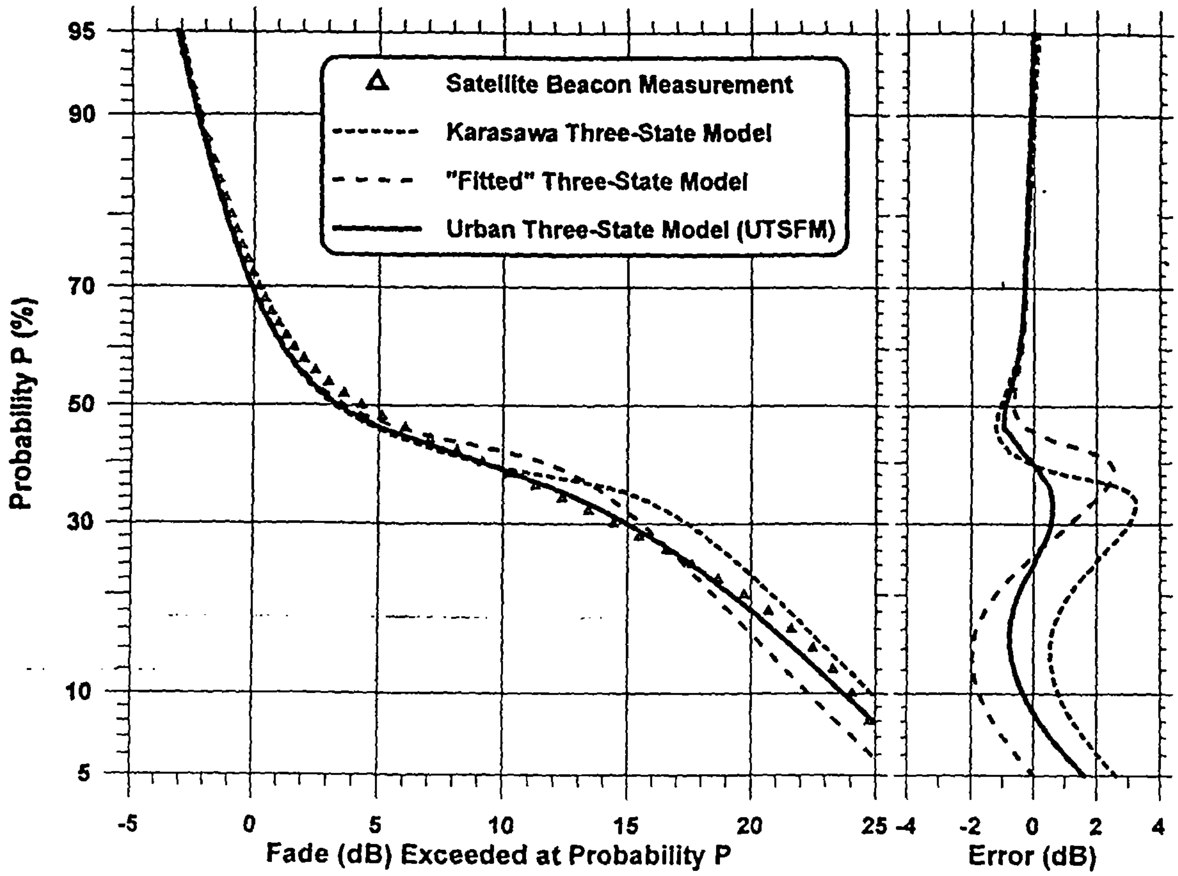
14 Goldhirsh, J. and W. J. Vogel [1998], Handbook of Propagation Effects for Vehicular and Personal Mobile Satellite Systems," APL JHU Technical Report A2A-98-U-0-021 and EERL/UOT Technical Report EERL-98-12A, December.

distributions at 32° elevation and at a frequency of 1.5 GHz.[15] The right-hand curves represent the fade differences between the measured and modeled distributions at different percentages.

---

15 It should be noted that Inmarsat's Atlantic Ocean Region-West satellite, which is located at 54°W longitude, provides an elevation angle of 30° or greater for all of the CONUS east of a line stretching from Chicago to a point between San Antonio and El Paso. Therefore the propagation data in Figure 3-1, which is for an elevation angle of 32°, is quite appropriate for assessing the interference to Inmarsat.

Figure 3-1. Measurement Data and Propagation Model Results as a Cumulative Distribution Function

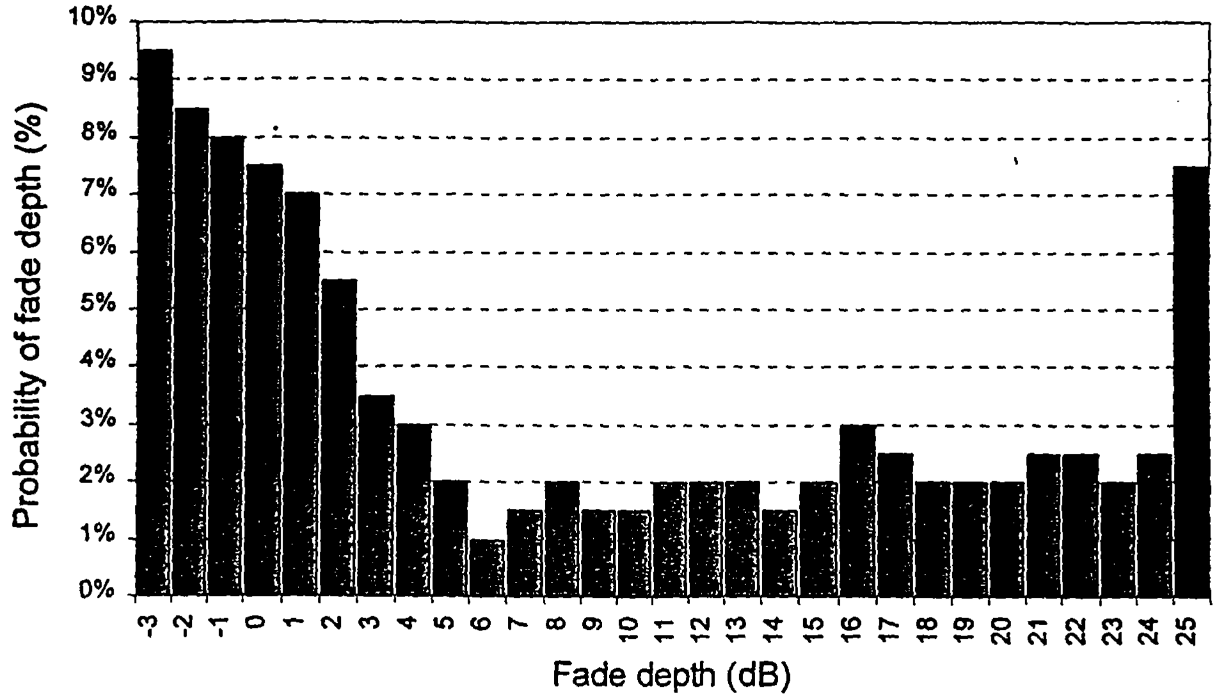


The probabilities along the vertical scale conforms with the ITU-R accepted convention of representing the "Probability of exceeding the abscissa value" as opposed to Hess's convention which gives the "Probability that the fades are smaller than the abscissa values." The important point about the data given in Figure 3-1 is that it fully defines the path attenuation up to 95% probability (equating to 5% probability under the convention used by Hess), which is far more complete than the data provided by the Hess model, for the reasons provided in Section 3.1 above. Thus, the data in Figure 3-1 allows us to fully analyze the chances that the predicted fade will not be effective in shielding the Inmarsat network from the interfering Motient signals.

An interesting point to note from Figure 3-1 is that it predicts that the fade depth will exceed 0 dB for 70% of the time, i.e. for 30% of the time the path attenuation is actually negative and there is a net propagation path power *enhancement* relative to the clear sky condition, which is a result of the multi-path from building reflections in the urban environment.

The data in Figure 3-1 is a *cumulative distribution function*. From this we have calculated the *probability density function* which simply gives the probability of the attenuation being within a set of attenuation sub-ranges or "bins", and this is given in Figure 3-2. Each bin is shown as a bar in the graph. The –1 dB bin, for example, refers to a range of attenuation levels from –1.5 dB to –0.5 dB, so each bin covers an attenuation range of 1 dB. The only exceptions are the bins at the extremes of the attenuation range which additionally include all attenuation levels outside the bounds of the distribution given in Figure 3-1.

Figure 3-2. Measurement Data and Propagation Model Results as a Probability Distribution Function



The next step in calculating the average attenuation for a number of Motient mobile transmitters is to calculate the weighted attenuation for each bin, by multiplying the attenuation (converted to a linear value) by the probability associated with that bin. Adding up all these weighted bin attenuation values gives the average attenuation, which is then converted back to a dB value. The result is an average attenuation value of 1.9 dB for the data in Figures 3-1 and 3-2.

The average attenuation of 1.9 dB may be interpreted as representing the "average shielding" obtained when the fades encountered by the entire population of users are averaged over the coverage area. It is interesting to note that this average fade is close to the median value (50%) in Figure 3.1 which tells us that 50% of the users will experience shielding smaller than 3 dB. This average value of 1.9 dB is a far cry from the 22.4 dB value that Motient proposes we should use for this calculation.

Note that the data in Figures 3-1 and 3-2 are taken from measurements made in Tokyo, which is an urban environment with a large number of concentrated high-rise buildings. In many US cities the shielding due to the buildings is likely to be less than in Tokyo and so the average attenuation likely will be less than the 1.9 dB calculated above. Of course in suburban areas the average attenuation would be even less.

3.4 Significance of the street directions on the blocking factor

The data given in Figures 3-1 and 3-2 above assumes random positioning of the mobile subscribers in the streets of Tokyo. The heading directions of the streets are essentially also random - some may line up with the azimuth direction of the satellite and others will be at right angles to the azimuth direction, and of course others will be somewhere in between these two extremes. In the Hess analysis provided by Motient the heading direction of the street (parameter is called "HEAD") is assumed to be at 45° relative to the azimuth direction of the satellite.[16] Hence the effects of heading were averaged out. However, Hess himself observed that the signal attenuation is highly dependent on the street heading direction – here are the comments of Hess in his 1980 report of the measurements:[17]

> *"The importance of street heading became clear during the data collection phase so this parameter was quantized into 45° steps. For example, in cities like Denver and San Francisco with streets running NE/SW, little signal shadowing was apparent, despite the presence of large buildings on both sides of the street. This is because the satellite itself was located to the SW and thus a line-of-sight signal component could readily be maintained."*

To quantify the effect described by Hess we have calculated cumulative fade distributions from measured (not modeled) UHF distributions given in Hess's paper for the two extreme cases of (a) streets aligning with the satellite azimuth, and (b) streets that are orthogonal to the satellite azimuth. The results are shown in Figure 3-3 where we have used the convention showing the probability of exceeding abscissa fades. Note the huge difference between the two curves, which illustrates how sensitive the path attenuation is to the street alignment. For streets aligned with the satellite azimuth the path attenuation can be exceedingly low. For example, only 30% of the time does the fade exceed 4 dB when the streets are aligned with the satellite compared to approximately 24 dB when they are not.[18]

There are two important ramifications of this phenomenon, as follows:

1. As Inmarsat has demonstrated in its Comments to this proceeding, harmful interference to Inmarsat's uplink would occur with a relatively small number of Motient mobile transmitters using a shielding factor of 3 dB. If such a small number were found to be operating in streets aligned with the Inmarsat satellite azimuth there would be almost no shielding.

2. The method of calculating the average shielding factor, described in Section 3.3 above, shows how the overall average attenuation is heavily influenced by the mobile

---

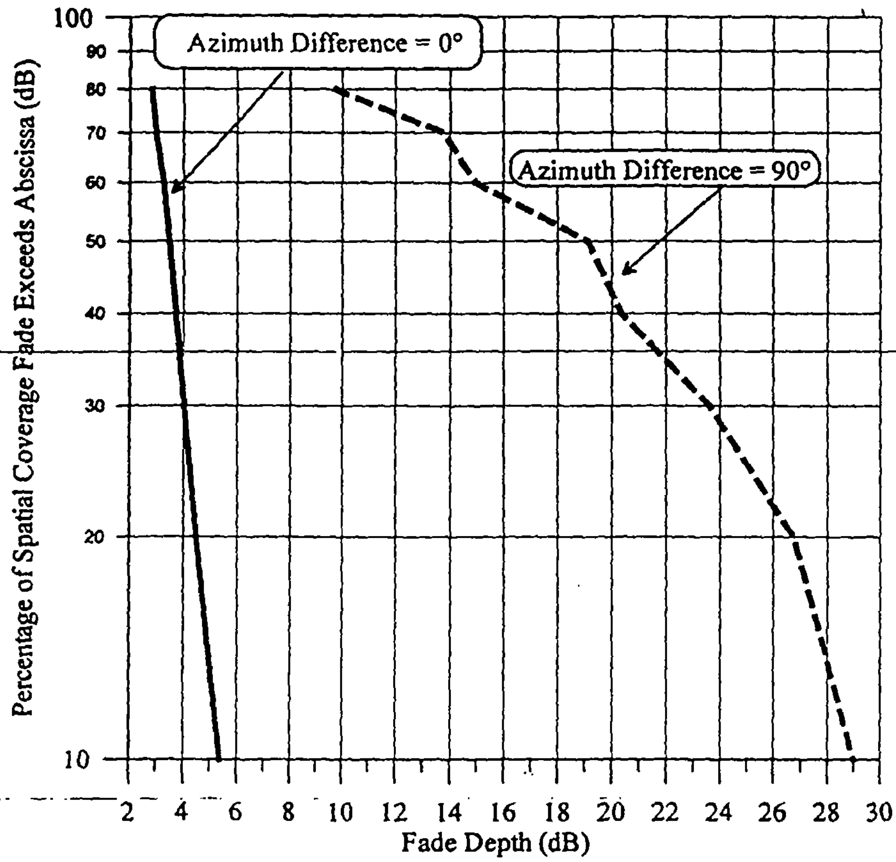
16 Motient Ex-Parte Presentation, July 6, 2001 (filed July 6, 2001), p. 5, footnote 7.

17 Hess, G.C., "Land-Mobile Satellite Excess Path Loss Measurements", IEEE Transactions on Vehicular Tech., Volume VT-29, No. 2.

18 It should be noted that, in his results, Hess showed experimental values outside the bounds of his model.

transmitters that are operating with relatively low signal attenuation. That averaging analysis could be extended to take into account the range of street heading directions, and would likely lead to even lower levels of average attenuation than that calculated in Section 3.3 above.

Figure 3-3. Comparison of Urban Fade Distributions at 860 MHz Measured by Hess [1980] in Denver for Streets whose Azimuths Approximately Align with the Satellite Azimuth (solid curve) and for Streets whose Azimuths are Approximately Orthogonal to the Satellite Azimuth (dashed curve).



4 Ancillary Terrestrial Systems in the 1610-1626.5 MHz Big-LEO Frequency Band Could Cause Uplink Interference to Inmarsat

Certain parties in this proceeding promote the use of an ancillary terrestrial component to MSS systems in the Big-LEO MSS frequency bands. This would involve potentially large numbers of terrestrial mobile transmitters operating in the 1610-1626.5 MHz band, which is immediately adjacent to the Inmarsat MSS uplink band (1626.5 MHz and above). The aggregate effect of the out-of-band emissions of these terrestrial mobile transmitters could, unless adequately controlled, cause harmful interference into the Inmarsat uplinks that are operating in the USA. This interference effect is identical to that described in the Technical Annex attached to Inmarsat's Comments in this proceeding, and the same interference results apply as presented there.[19]

5 Motient's Terrestrial System Will Directly Reduce the Spectrum Available for Use by the Motient Satellite System

In the Inmarsat Comments to the instant NPRM an analysis was provided that shows the severe uplink interference that Motient's satellite system would suffer from its own proposed terrestrial transmitters, if that terrestrial component is implemented.[20] That self-interference would inevitably lead to a loss of capacity in the MSS spectrum used by Motient. Based on additional information provided in Motient's Comments to this NPRM it is also now clear that Motient's proposed terrestrial system will use frequencies that otherwise could be used in the same or adjacent geographic area by the Motient satellite system, and thereby would directly reduce the spectrum available for use by the Motient satellite system. In each case, the end result would be that Motient would have to demand access to more L band spectrum than it really needs to provide just satellite services. This assertion is explained and justified in detail below.

The next generation Motient satellite design will use multiple spot beams which can be configured and combined in a variety of ways according to the Motient application.[21] Figure 5-1 below shows a subset of these Motient spot beams covering a portion of the USA. The exact size of the spot beams shown in Figure 5-1 is not crucial to the argument being developed here but every effort has been made to ensure that these spot beams are the same size as indicated by Motient in its FCC application.[22]

Various cell re-use patterns are possible with an array of spot beams as shown in Figure 5-1, ranging typically from a 4-cell pattern to a 7-cell pattern. Motient does not state in its application which it will use, but the conclusion below does not change whatever the re-use pattern is.

---

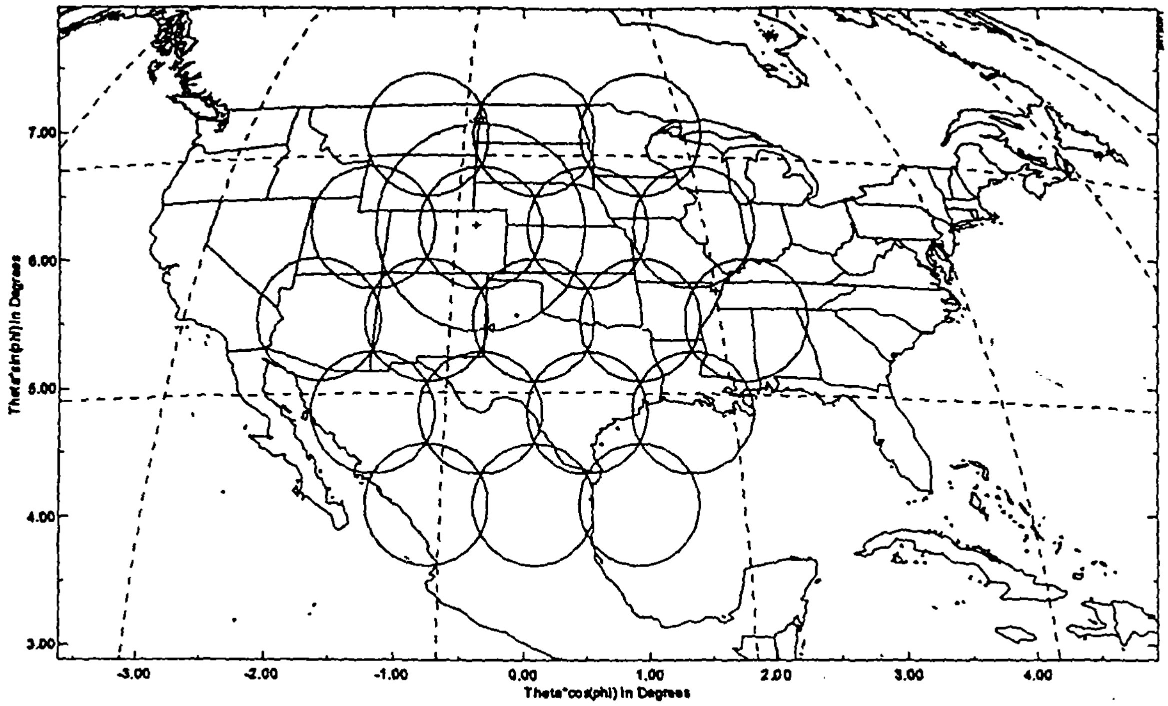
19 Inmarsat Comments, Technical Annex, Section 3.2, pp. 6-7.

20 Inmarsat Comments, Section 3.5, pp. 21-23.

21 *Mobile Satellite Ventures Subsidiary LLC Application for Assignment and Modification of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite System, et al.*, File No. SAT-ASG-20010302-00017, et al. (filed March 1, 2001) (the "*Application*"), Appendix A, Section 1.4, pp. 5-10.

22 *Mobile Satellite Ventures Subsidiary LLC Application for Assignment and Modification of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite System, et al.*, File No. SAT-ASG-20010302-00017, et al. (filed March 1, 2001) (the "*Application*"), Appendix A, p. 9, Figure 1-5.

Figure 5-1. Subset of Motient Spot Beams over USA



Consider the seven beams in the center of Figure 5-1. Between them they can use all of the satellite spectrum available with typically one quarter (for a 4-cell re-use pattern) or one seventh (for a 7-cell re-use pattern) of the available spectrum available in each beam. If we now superimpose Motient's proposed terrestrial system onto this beam pattern, let us consider which frequencies Motient could use for its terrestrial system in the center beam. Obviously Motient cannot use for its terrestrial system the spectrum used in the center beam by the Motient satellite system without taking that spectrum away from the satellite system. Furthermore, within the center beam, Motient cannot use for its terrestrial system any of the frequencies used by the Motient satellite system in the surrounding six beams without taking that spectrum away from satellite use in those beams, *because Motient's stated requirement for 10 dB isolation is not met.*[23,24] This is demonstrated by the 10 dB contour drawn in Figure 5-1 for one of the six beams surrounding the center beam. This contour significantly overlaps the center beam, preventing Motient from reusing the spectrum used for satellite service in that beam for terrestrial service in

23 Motient Consolidated Opposition to Petitions to Deny and Reply to Comments, May 7, 2001, Technical Appendix, p.3. Also see Motient Comments, Technical Appendix, Section III, p. 6.

24 Inmarsat does not agree that reuse between Motient's satellite and terrestrial systems is possible with only 10 dB satellite antenna discrimination. In the Inmarsat Comments is was demonstrated that with 10 dB antenna discrimination very high levels of self-interference would be caused to the Motient satellite system. However, if we accept Motient's claim that they can reuse frequencies with only a 10 dB antenna discrimination, then reuse of the terrestrially used frequencies by the satellite system in the adjacent beam simply is not possible because the antenna discrimination in the adjacent beams is significantly less than 10 dB over a very large part of that beam. In some parts of the adjacent beam the antenna discrimination is even as low as 3 dB or less.

the center beam. The same constraint obviously applies to the other surrounding beams, and consequently none of the spectrum used by Motient's satellite service in the middle seven beams of Figure 5-1 can be used for terrestrial service without taking that spectrum away from the satellite service. Since *all* of Motient's satellite spectrum is used by these seven beams, the use of any spectrum by Motient's proposed terrestrial system in the geographic area of a satellite beam inevitably means that spectrum can no longer be used for the provision of MSS in either that satellite beam or any of the immediately adjacent satellite beams. The result is a reduction in the number of times spectrum can be re-used in the satellite system, and therefore a reduction in the overall spectral efficiency of the satellite system.

The above conclusion is consistent with Motient's explanation of how its "dynamic radio resource manager" will operate.[25] Motient explains that, when a "micro-cell" is implemented (which corresponds to a terrestrial cell or cells) this takes away spectrum from the "macro-cell" (which corresponds to the satellite beam), and that spectrum can no longer be used by that macro-cell (or satellite beam). The result of this is that Motient will not be able to carry as much satellite traffic in its coordinated spectrum if it implements its terrestrial system.

Therefore, any spectrum used terrestrially by Motient within a satellite beam area will inevitably reduce the spectrum available for Motient to use within that beam, or the immediately adjacent beams, by its satellite system. This will lead to Motient demanding more spectrum at the annual international coordination of L-band MSS spectrum in Region 2 than it would do with a satellite-only MSS system. For example, assume that Motient had successfully coordinated, based on actual satellite user requirements, 20 MHz of L-band spectrum at the multilateral Region 2 coordination meeting prior to any of its proposals to implement an ancillary terrestrial system. If it were to implement its proposed terrestrial system and use say 7 MHz of this 20 MHz in its terrestrial network within a high-traffic beam area such as the north-east corridor of CONUS, then only 14 MHz would be left available for the Motient satellite users in and around this area. Presumably there would still be a demand for 20 MHz of spectrum for the satellite users, and so Motient would be forced to go to the next multilateral coordination meeting and request a total of 27 MHz of L-band spectrum. This would be totally inappropriate and in violation of the multilateral agreements with other nations that have already been reached. If on the other hand Motient's MSS satellite operations does not require the whole 20 MHz of spectrum then the US is obligated, by the multilateral coordination agreement, to make the spectrum not required available to the other MSS operators that serve Region 2.

---

25 Motient Comments, Technical Appendix, pp. 3-4, including footnote 5.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

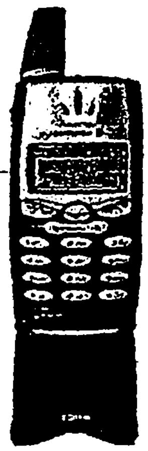
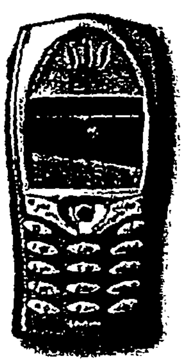
I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing submission, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

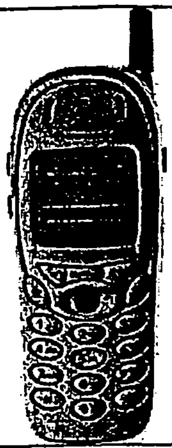
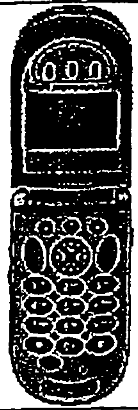
Richard Barnett

Richard J. Barnett, PhD, BSc
Telecomm Strategies, L.L.C.
6404 Highland Drive
Chevy Chase, Maryland 20815
(301) 656-8969

Dated: November 13, 2001

Exhibit A

	Make & Model: ERICSSON R520m Weight: 105 g Size: 130 x 50 x 16 mm Recommended Retail Price: ~$150
	Make & Model: ERICSSON T39m Weight: 86 g Size: 96 x 50 x 18 mm Recommended Retail Price: ~$270
	Make & Model: ERICSSON T68m Weight: 86 g Size: 100 x 48 x 20 mm Recommended Retail Price: ~$450

	Make & Model: MOTOROLA Ti280e Recommended Retail Price: ~$150
	Make & Model: MOTOROLA V66e Weight: 79 g Size: 84 x 44 x 21 mm Recommended Retail Price: ~$225
	Make & Model: MOTOROLA L7089 Weight: 108 g Size: 130 x 46 x 24.5 mm Recommended Retail Price: ~$150